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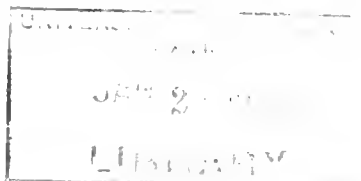
BULLETIN NO. 110

# NORTH BAY AQUEDUCT



DECEMBER, 1961

EDMUND G. BROWN  
Governor  
State of California



WILLIAM E. WARNE  
Administrator  
The Resources Agency of California  
and Director  
Department of Water Resources



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THE RESOURCES AGENCY OF CALIFORNIA  
DEPARTMENT OF WATER RESOURCES

1120 N STREET, SACRAMENTO

December 6, 1961

Honorable Edmund G. Brown, Governor, and  
Members of the Legislature of the  
State of California

Gentlemen:

I have the honor to transmit herewith Bulletin No. 110, "North Bay Aqueduct". The investigation leading to this bulletin was initiated by the department in 1960. Its purpose is to make available to local interests information on the potential demand for and probable cost of water from the North Bay Aqueduct under existing pricing and repayment policies.

The North Bay Aqueduct was authorized by the Legislature in 1957, as a feature of The California Water Plan. Funds in the amount of \$1,340,000 were appropriated for preparation of final design and contract specifications. Subsequently, \$1,000,000 was appropriated for right-of-way acquisition. The project is included in the Burns-Porter Act as a feature of the State Water Facilities.

The bulletin concludes that there is a potential demand for water in the North Bay Area, that the North Bay Aqueduct is the most feasible initial development to meet near-future requirements for supplemental water, and that construction should be started immediately to provide water to Napa County by 1966.

Sincerely yours,

*William E. Warne*  
Director





STATE OF CALIFORNIA  
DEPARTMENT OF WATER RESOURCES

EDMUND G. BROWN, Governor  
WILLIAM E. WARNE, Director of Water Resources  
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The investigation leading to this report  
was conducted under the direction  
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by

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David K. Marty . . . . . Engineering Aid II

Aqueduct design and cost estimates were prepared by the Division  
of Design and Construction

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CALIFORNIA WATER COMMISSION

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Chief Engineer

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Executive Secretary

## CHAPTER I. THE RE-EVALUATION PROGRAM

The re-evaluation study of the North Bay Aqueduct was undertaken by the Department of Water Resources pursuant to a statement made by the Director of Water Resources to local interests from the north bay counties at a public meeting held in Sacramento on April 28, 1960. This meeting was called by the former director to obtain a decision from the north bay interests regarding the immediate course of action to be taken by the department on the North Bay Aqueduct. The meeting, which was considered necessary because of the apparent lack of unanimity on the part of local interests regarding the North Bay Aqueduct, was well attended by legislators, members of county boards of supervisors, representatives of water agencies and agricultural interests, and interested individuals from the four north bay counties.

In consideration of the high degree of interest expressed by the local representatives at the April 28th meeting, it was agreed that the North Bay Aqueduct would be reanalyzed in light of more recent physical data and pricing and repayment policy, that acquisition of lands, easements, and rights of way would proceed in areas where the aqueduct alignment was firmly fixed, and that an answer would be made available by January 1, 1961. However, because of delays in getting the work program underway, the time required in scheduling the many meetings with local water agencies to discuss the developed data, and the time required for the evaluation of the data and preparation of a formal reply by the responsible local interests, the investigation extended beyond the original due date.

This report sets forth results of the North Bay Aqueduct re-evaluation study. It presents up-to-date physical, engineering, and economic data with respect to demands for water from the North Bay Aqueduct and the costs thereof, draws conclusions from the developed data, and sets forth recommendations regarding the future course of action by the department with respect to the North Bay Aqueduct and other potential water development for the North Bay Area.

### History of North Bay Aqueduct

Investigation of the North Bay Aqueduct was originally authorized by the Abshire-Kelly Salinity Control Barrier Acts of 1953 and 1955. The 1955 Act called for studies for ". . . purposes of developing complete plans of the means of accomplishing deliveries of fresh water to the San Francisco Bay Area . . .", including the counties of Solano, Napa, Sonoma, and Marin. Results of this study were published in Department of Water Resources Bulletin No. 60, entitled "Interim Report to the California State Legislature on the Salinity Control Barrier Investigation", dated March, 1957.

Bulletin No. 60 recommended authorization of the North Bay Aqueduct for construction as a feature of The California Water Plan, and the appropriation of funds for acquisition of lands, easements, and rights of way and preparation of construction plans and specifications. The Legislature, by enactment of Chapter 2252, Statutes of 1957, authorized the North Bay Aqueduct as a unit of The California Water Plan and appropriated \$1,340,000 for the preparation of construction plans and specifications. The 1959 Legislature appropriated

\$1,000,000 for acquisition of lands, easements, and rights of way in connection with the North Bay Aqueduct.

As work proceeded with preparation of final plans and specifications, it became increasingly apparent that the attitude of the water users in the four north bay counties did not indicate unanimity of interest in the North Bay Aqueduct. This indication was brought out in a hearing on the aqueduct held on August 27, 1958, in Napa by the Legislative Subcommittee on Financial and Economic Policy for State Water Projects. As a result, work on the project was suspended for more than a year.

Recognizing the need for an immediate decision concerning the course of action by the department on the North Bay Aqueduct, the Director called the previously mentioned public meeting which was held on April 28, 1960. The agreement reached during that meeting constituted the authority for the current re-evaluation study.

#### Objective and Scope of Study

The North Bay Aqueduct re-evaluation study has as its objective the determination of probable demand for water within the potential aqueduct service area in light of recent past and indicated future trends of land use, costs of aqueduct water, current pricing and repayment policy, local water development alternatives, and ability of local users to pay, primarily for irrigation water. The results of the study, after review and comment by the potential water users, will provide the basis for a decision by local interests in the north bay counties as to whether to proceed with negotiations looking toward the execution of contracts for purchase of water from the North Bay Aqueduct.

The re-evaluation study is concerned primarily with three significant factors or events which have occurred or have become evident since the publication of Bulletin No. 60, and which materially affect estimates of future water demand from the North Bay Aqueduct. These three factors are as follows:

1. Indicated greater population, necessitating an upward revision in population projections and water requirements;

2. Active steps by local water service agencies to develop local water supplies or to contract for imported supplies; and

3. Announcement by the Governor of cost allocation, pricing, and repayment policy and contract principles to be followed by the Department of Water Resources.

The scope of the re-evaluation study was limited to consideration of that portion of the Counties of Marin, Sonoma, Napa, and Solano which drains into San Francisco Bay. For purposes of the report, this area, which represents the maximum potential service area of the North Bay Aqueduct, is designated the "North Bay Area". The North Bay Area is delineated on Plate 1, entitled "Area of Investigation". The Solano Irrigation District was not considered a part of the potential service area for agricultural water since it is presently served by the Solano Project of the U. S. Bureau of Reclamation. However, urban requirements considered did include those cities within the Solano Irrigation District. Planning studies were pointed toward an aqueduct capacity which would meet the demands for

water to the year 1990. This is in consonance with the planning for the State Water Facilities. Possible water supply projects which could supplement the North Bay Aqueduct, both with respect to service area and timing of need, were given study and analysis, utilizing all presently available data. Such analysis was considered necessary in order to arrive at the best project or combination of projects to serve the North Bay Area.

### Conduct of Studies

The North Bay Aqueduct re-evaluation study involved first the updating in the office of those data and factors which could have an effect upon water demand from the aqueduct. Basic data were reviewed and revised in accordance with the latest information available to the department. Representatives of potential water users throughout the service area were then consulted to apprise them of preliminary results of the studies, and to obtain from them any additional data which would assist the department in the conduct of its studies.

Additional office studies were then made, to synthesize the preliminary data and formulate a North Bay Aqueduct which appeared to meet the projected 1990 supplemental water demands within the North Bay Area. The costs of water resulting from these studies were used as a basis for further discussion with potential water users, to ascertain if there would be an actual demand for aqueduct water at the indicated costs. As a final item, the interest expressed for aqueduct water at the indicated costs was used as the basis for the recommendations in this report.





## CHAPTER II. WATER SUPPLY AND REQUIREMENTS

This chapter discusses and evaluates the existing and probable near future water supplies available to the North Bay Area, presents a derivation of projected water requirements to the year 1990, and equates the available water supplies with determined water requirements to indicate the potential 1990 requirements for supplemental water. The supplemental water requirements, so determined, provide the basis for the formulation and economic evaluation of the North Bay Aqueduct, which is discussed in the ensuing Chapter III.

### Available Water Supply

The present developed water supply in the North Bay Area is obtained from surface reservoir storage, from ground water basins, and from imports from Putah Creek (Monticello Reservoir), Cache Slough, and the Russian River. Additional water supplies will be imported from the Russian River in the near future. Available information relative to each of these sources was collected and reviewed in order to determine the amount, timing, and place of use of all existing and near future water supplies. This information is discussed for each of the four north bay counties in the following paragraphs. It should be noted that for this report the assumption was made that available water supplies would generally be usable within the entire drainage area unless specific distribution agreements precluded such assumption. While the total available supply in each of the counties would remain the same, certain assumptions were made

as to trend of land use within the county during the period from 1960 to 1990, particularly as the type of water demand changes with encroachment of urban development on present agricultural lands.

### Marin County

Two water agencies, the Marin Municipal Water District and North Marin County Water District, develop and distribute all of the surface water supplies in Marin County, except for several small commercial water agencies which serve a few consumers in coastal communities. At the present time, the firm annual yield of developed surface water supplies within the county aggregates about 17,600 acre-feet. During normal water years it is possible to operate existing facilities to obtain a higher temporary yield, such as in 1959 when reported water deliveries amounted to about 21,600 acre-feet.

With the completion of Nicasio Reservoir in 1961 by the Marin Municipal Water District, an additional firm annual yield of 13,200 acre-feet became available. This will increase the total yield of local surface water supplies to an estimated 30,800 acre-feet per year. In addition to this yield from local development, the North Marin County Water District has contracted for an annual import of 10,000 acre-feet of water from the Russian River through facilities of the Sonoma County Flood Control and Water Conservation District. It is anticipated that construction of the project will be completed in December 1961. Ground water sources, although contributing a minor portion of the total water supply, were not considered sufficient for quantitative evaluation.

The total present and near future water supply available to Marin County, therefore, is estimated to be about 40,800 acre-feet per year. Since the entire water supply is treated for urban use, it is probable that it will continue to be available only for such use. This is considered a valid assumption in view of the rapid trend toward urbanization of the county. The present and contemplated water supply within the organized districts, as described, should be adequate until about 1975. However, the coastal communities outside the districts are presently having difficulty in obtaining adequate water supplies.

#### Sonoma County

The annual firm yield of presently developed surface waters in Sonoma County is estimated to be about 1,200 acre-feet. U. S. Geological Survey Water Supply Papers 1426 and 1495 contain the following records of ground water pumpage in 1952; Petaluma Valley, 1,800 acre-feet; Kenwood Valley, 260 acre-feet; and Sonoma Valley, 2,400 acre-feet. Present knowledge indicates that any appreciable increase of this pumpage over a prolonged period would result in sea water intrusion from beneath the bay. Reports of the Sonoma County Flood Control and Water Conservation District indicate that about 9,700 acre-feet of water per year will be delivered to the vicinity of Petaluma and Sonoma upon completion of aqueduct facilities presently under construction from the Russian River.

Therefore, following construction of the Petaluma and Sonoma Aqueducts, the total annual water supplies available to

Sonoma County from both surface and underground sources will be about 15,400 acre-feet. Of this amount, it is estimated that 14,800 acre-feet will be available for urban use in 1990, and 600 acre-feet for agricultural use. The current studies indicate that supplemental urban water is presently needed in the City of Sonoma, but that such water could be obtained from sources other than the North Bay Aqueduct, such as the Sonoma aqueduct from the Russian River.

### Napa County

The analysis of presently developed surface water supplies within Napa County resulted in an estimate of total annual yield of 19,000 acre-feet. Ground water pumpage in 1950 was reported in U. S. Geological Survey Water Supply Paper 1495 to be approximately 5,500 acre-feet. This value is considered to be the annual safe ground water yield. Therefore, the total available supply of surface and ground water in Napa County is about 24,500 acre-feet per year. It was estimated that of this amount, 20,400 acre-feet will be available for urban use in 1990, and 4,100 acre-feet for agricultural use. The critical present water problem in Napa County is centered in the City of Napa, which will fully utilize its available water supply by about 1966.

### Solano County

Studies of local surface water supplies in Solano County indicated a firm annual yield of 7,500 acre-feet. Ground water pumpage in 1952, as shown in a preliminary report of the U. S. Geological Survey was estimated to be 6,500 acre-feet per

year in the Fairfield-Suisun area, and 1,400 acre-feet per year in the Green Valley area. In addition, an estimated annual import of 55,000 acre-feet of water from the Solano Project of the Bureau of Reclamation, as well as the entire 23,000 acre-feet from the Cache Slough diversion of the City of Vallejo, is available for urban use within the potential service area of the North Bay Aqueduct.

The total water supply available in Solano County from the foregoing sources, therefore, is estimated to be 93,400 acre-feet annually. Of this amount, an estimated 59,900 acre-feet will be available for urban use and 33,500 acre-feet for agricultural purposes in 1990. At the present time, an additional 1,300 acre-feet of water per year is imported to Benecia from Napa County. However, it was assumed that by 1970 this import would no longer be available as Napa will need its entire supply.

#### Summary of Available Water Supply

The estimates of present and near future water supplies available to the North Bay Area are summarized in Table 1.

TABLE 1

ESTIMATED AVAILABLE WATER SUPPLIES  
IN NORTH BAY AREA

(In acre-feet per year)

Source of water supply	County				Total
	Solano	Napa	Sonoma	Marin	
Surface reser- voirs	7,500	19,000	1,200	17,600	45,300
Ground water pumpage	7,900	5,500	4,500	0	17,900
Imports	<u>78,000</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>78,000</u>
Present supply	93,400	24,500	5,700	17,600	141,200
Under con- struction	0	0	4,500	23,200	27,700
Anticipated	<u>0</u>	<u>0</u>	<u>5,200</u>	<u>0</u>	<u>5,200</u>
Totals	93,400 <sup>1/</sup>	24,500 <sup>2/</sup>	15,400	40,800	174,100

<sup>1/</sup> 33,500 acre-feet for agricultural use by the Solano Irrigation District within the North Bay Aqueduct Service Area.

<sup>2/</sup> 300 acre-feet available for use above Conn Reservoir.

Water Requirements

Water requirements in the North Bay Area were projected for each county on the basis of population and land use data and forecasts. Urban water requirements were estimated, by decades, as the products of projected population and annual per capita water consumption. Potential agricultural water requirements were estimated as the products of the projected 1990 crop pattern and the unit water requirements of the various crops. The projected 1990 crop pattern was developed from consideration of cropping trends, as indicated by land use survey data, and the suitability

of lands for irrigated crops, as determined from an earlier land classification survey.

### Urban Water Requirements

Recent population projections for the State, and individual counties, indicated that earlier population forecasts, on which the water requirements presented in Bulletin No. 60 were based, required revision upward. Information on population considered during the re-evaluation studies included the comments of Mr. Van Buren Stanbery, economic and population consultant, and population projections in the San Francisco Bay Area in a report, entitled "Future Development of the San Francisco Bay Area, 1960-2020", prepared by the Department of Commerce for the Corps of Engineers and dated December 1959. Inasmuch as parts of all four counties considered are located outside of the potential service area of the North Bay Aqueduct, it was necessary in each case to determine that portion of the population of the county located within the San Francisco Bay Area. This was accomplished by utilizing the populations in judicial townships within each county and the population-density maps prepared by the Department of Commerce. Table 2 presents the projected population, by decades, for each of the four north bay counties, both as total county population and as that part of the county located within the North Bay Area.

TABLE 2  
PROJECTED POPULATION IN NORTH BAY COUNTIES  
(In thousands)

Year	Solano County		Napa County		Sonoma County		Marin County		Total	
	North		North		North		North		North	
	Bay		Bay		Bay		Bay		Bay	
	Area		Area		Area		Area		Area	
1960	135	115	66	65	147	40	147	146	495	366
1970	200	153	100	97	220	59	245	243	765	552
1980	310	217	145	141	325	97	350	347	1,130	802
1990	465	314	215	209	455	142	440	435	1,575	1,100



Estimates of per capita water use in the re-evaluation studies included both municipal and industrial, but no attempt was made to separate these two items. The estimates were developed after review and evaluation of data on file with the department, and data on present and projected per capita water demand obtained from other agencies. Table 3 presents a summary of the estimated per capita water use for urban areas within the north bay counties. In Table 3, the term "urban" refers to intensely developed areas containing both municipal and industrial development, whereas the designation "rural" represents scattered residential areas.

TABLE 3

## ESTIMATED PER CAPITA WATER USE IN NORTH BAY AREA

(In acre-feet per year)

Population center	1970		1980		1990	
	Urban	Rural	Urban	Rural	Urban	Rural
<u>Solano County</u>						
Vallejo Township	.147		.157		.168	
Benecia Township	.147		.157		.168	
Green Valley Township		.179		.185		.191
Suisun Township	.213	.179	.230	.185	.244	.191
Denverton-Montezuma Townships						.191
<u>Napa County</u>						
Calistoga Township	.151	.179	.168	.185	.179	.191
St. Helena	.151	.179	.168	.185	.179	.191
(St. Helena	.147	.179	.157	.185	.168	.191
Angwin						
Napa Township	.151		.168		.179	.191
(Yountville	.235		.244		.258	.191
(Napa	.151	.179	.168	.185	.179	
(Middleton						
<u>Sonoma County</u>						
Sonoma Township	.151	.179	.168	.185	.179	
(Kenwood	.151	.179	.168	.185	.171	.191
(Glen Ellen	.151	.179	.168	.185	.179	.191
(Sonoma	.151	.179	.168	.185	.179	.191
Petaluma Township						
<u>Marin County</u>						
Novato Township	.151		.162		.173	
San Rafael Township	.151		.162		.173	
Sausalito Township	.151		.162		.173	
Tomaes Township	.151		.162		.173	

Total urban water requirements in the North Bay Area were computed by multiplying the projected population in Table 2 by the estimated annual per capita water use in Table 3. The resulting estimates are presented in Table 4, by decades from 1960 to 1990, for the portion of the four counties within the North Bay Area.

TABLE 4  
ESTIMATED TOTAL ANNUAL URBAN WATER  
REQUIREMENTS IN NORTH BAY AREA

(In acre-feet)

Year	: Solano : County	: Napa : County	: Sonoma : County	: Marin : County	: Total
1960	20,800	12,100	4,600	21,600	59,100
1970	24,500	19,800	9,200	36,700	90,200
1980	37,500	29,200	16,400	56,200	139,300
1990	58,400	45,100	25,500	75,300	204,300

#### Agricultural Water Requirements

As previously stated, the 1990 agricultural water requirements were estimated as the products of the projected 1990 crop pattern and the unit water requirements of the various crops. In developing these water requirements, data from a present land use survey (which provided the basis for future land use) were utilized in conjunction with a land classification survey (which indicated the suitability of lands for various types of crops).

Land Classification and Use. Historical land use data on file with the department have been collected in connection with previous studies in the North Bay Area. However, these data

represented land use of several years ago, and lacked the detail necessary for the current re-evaluation. Therefore, it was considered desirable that up-to-date land use be obtained within the North Bay Area, particularly as a requisite to advanced planning studies on the North Bay Aqueduct.

In developing the projected 1990 agricultural water requirements within the North Bay Area, it was necessary to determine the amount and quality of land that will be available for irrigated agriculture, recognizing that urban expansion will continue to encroach on land presently devoted to agriculture. Land use projections prepared by the Department of Commerce for the Corps of Engineers were utilized as a basis for projecting the 1990 land use. It was believed that these projections were the best data available on 1990 agricultural development, within the time available for completion of this study. However, a detailed survey of present land use, initiated in September 1960, was used in the re-evaluation study to modify the Department of Commerce land use projections.

Having determined the amount and location of available agricultural lands in 1990, it was necessary to determine their suitability for irrigated agriculture. The land classification survey conducted during the preparation of Bulletin No. 2, "Water Utilization and Requirements of California, June 1955", provided the base for the projections adopted for this study. In Bulletin No. 2, the lands were classified only as irrigable or nonirrigable. Therefore, it was necessary to evaluate the relative quality and crop adaptability of lands which would be available for agriculture in 1990.

Table 5 indicates, by each of the four counties, a reconnaissance classification of lands in the North Bay Area which would be available for irrigated agriculture in 1990. These data were subsequently used in conjunction with economic data as one of the factors to determine the amount and nature of the irrigated crops which could be expected in the area in the year 1990.

TABLE 5  
CLASSIFICATION OF PROJECTED 1990 AGRICULTURAL  
LANDS IN NORTH BAY AREA<sup>1/</sup>

(In acres)

Classification <sup>2/</sup>	Solano : County	Napa : County	Sonoma : County	Marin : County	Total
V	9,400	28,200	17,100	900	55,600
Vp	2,100	0	0	0	2,100
Vs	48,200	5,000	20,800	4,300	78,300
H	1,500	7,300	11,600	1,500	21,900
Hp	<u>100</u>	<u>3,600</u>	<u>5,900</u>	<u>0</u>	<u>9,600</u>
Total irrigable	61,300	44,100	55,400	6,700	167,500

<sup>1/</sup> Excludes Solano Project Service Area and 1990 projected urban areas.

<sup>2/</sup> Classification legend (refers to climatically adapted crops):

- V - suited to all crops.
- Vp - suited to shallow, or moderately deep-rooted crops.
- Vs - suited to crops tolerant to excess concentrations of soluble salts.
- H - suited to crops which can be grown on slightly or moderately rolling topography.
- Hp - suited to shallow, or moderately deep-rooted crops which can be grown on slightly or moderately rolling topography.

Table 5 shows that a total of 167,500 acres are potentially capable of being irrigated in 1990. This acreage could require water in the amount of some 350,000 acre-feet per

year. However, as discussed later, this requirement will be substantially reduced when economic factors are taken into consideration.

Crop Projections. The pattern and acreage of the various irrigated crops projected for 1990 development in the North Bay Area were based upon the following considerations: (1) climatic conditions and crop adaptability; (2) present cropping patterns; (3) cost of water at the farm head gate; (4) agricultural payment capacity; (5) comparative advantage of producing particular crops in the area; (6) availability of markets; and (7) requirement for capital investment. The first two of the foregoing are physical factors. The latter five considerations are intimately associated with economic factors which will be evaluated in this section and in Chapter III, insofar as such evaluations can be made.

Comparison of the payment capacity for various crops with the cost of irrigation water indicates that certain crops and areas could not afford to pay for water from the North Bay Aqueduct or any other potential project. This is due either to low crop payment capacity or to high distribution costs, or both. However, in order to have a balanced agricultural economy it was considered desirable to include in the crop projections certain crops which, by themselves, do not have sufficient payment capacity.

The cropping pattern and location is, of course, dependent on the cost of aqueduct water which, in turn, is dependent upon the quantity of water to be delivered. Since

both of these factors are variable, each being a function of the other, it was necessary to assume several crop patterns, utilizing a range of farm head gate water costs for water under the several crop patterns. In all such studies, the cost of distribution facilities becomes a significant factor in the determination of the particular crops, or areas, to be included or excluded from the potential service area. Although the cost of distribution is not part of the cost of a North Bay Aqueduct, it is an essential element of cost of water to the user, and must be included in the estimate of total cost of water.

Table 6 summarizes the projected 1990 land use by groups of crops for each county within the North Bay Area. The projected acreages are considered to represent the maximum irrigated agriculture that could be served from the North Bay Aqueduct. They reflect a substantial reduction from the potential acreage that is physically suited for irrigation, as presented in Table 5.

TABLE 6  
PROJECTED 1990 CROP PATTERN IN  
NORTH BAY AREA 1/

(In acres)

Crop group	: Solano : : County :	Napa : County	: Sonoma : : County :	Marin : : County :	Total
Orchard and vines	2,100	26,400	16,400	1,200	46,100
Truck	7,100	6,000	9,000	1,400	23,500
Field	11,200	800	400	0	12,400
Forage	<u>1,100</u>	<u>800</u>	<u>2,800</u>	<u>0</u>	<u>4,700</u>
Totals	21,500	34,000	28,600	2,600	86,700

1/ Excludes Solano Irrigation District and 1990 projected urban areas.

Unit Use of Water. Having first developed a projected 1990 crop pattern, the second step in evaluation of water requirements in the North Bay Area involved the determination of unit values of water use for the individual crops. Available data on unit use of water by crops that could be grown in the North Bay Area were reviewed and revised. Unit use data which had been developed for crops in climatically similar areas were utilized, with appropriate modification. Table 7 presents estimated unit values of water use for the various crops that could be grown in the North Bay Area. These values represent the unit application of water, and are generally equivalent to the farm head gate delivery.



TABLE 7

ESTIMATED ANNUAL UNIT VALUES OF WATER USE  
BY CROPS IN NORTH BAY AREA

(In feet of depth)

Crop	: Marin- :		: Solano County	
	:Sonoma : Napa :		:	
	:Counties:County:		V, Vs, H, Hp :	Vp <sup>1/</sup>
Pears	1.8	1.9	2.1	
Walnuts	2.0	2.1	2.2	
Prunes	1.4	1.4		
Wine Grapes	1.1	1.2		
Sweet Corn	1.5	1.5	1.6	1.7
Cauliflower	1.5	1.5	1.6	1.7
Tomatoes		1.5	1.6	1.7
Asparagus	1.5	1.5	1.6	1.7
Grain-Sweet Corn <sup>2/</sup>	2.1	2.1	2.2	2.4
Cauliflower- tomatoes <sup>2/</sup>		2.2	2.4	2.5
Cauliflower-Sweet Corn <sup>2/</sup>	2.2	2.2	2.4	2.5
Milo	1.5	1.5	1.6	
Corn Silage	1.5	1.5	1.6	
Sugar Beets			1.6	1.7
Safflower			1.6	
Field Corn	1.5	1.5	1.6	
Barley	1.3	1.3	1.3	1.4
Oats	1.3	1.3	1.3	1.4
Grain	1.3	1.3	1.3	1.4
Barley-Milo <sup>2/</sup>	2.1	2.1	2.2	
Oats-Corn Silage <sup>2/</sup>	2.1	2.1	2.2	
Sugar Beets-Corn <sup>2/</sup>			2.4	
Safflower-Milo <sup>2/</sup>			2.4	
Alfalfa	2.5		2.9	
Beef Pasture	2.6	2.6	3.0	
Dairy Pasture	2.6	2.6	3.0	

<sup>1/</sup> Land class legend in Table 5.<sup>2/</sup> Double crops.

Year 1990 Agricultural Water Requirements. The agricultural water requirements under 1990 development within the North Bay Area were evaluated as the product of the unit values of water use and the projected acreages of the individual crops, with appropriate allowance for conveyance losses from the aqueduct and distribution system. These requirements are set forth in Table 8 for each of the four north bay counties. It should be emphasized that the 1990 agricultural water requirements are based on estimated payment capacities. Areas not having sufficient payment capacity to meet the cost of water have been eliminated on this basis only. Whether the remaining areas will actually receive water depends on the willingness of the agricultural water users to purchase water at the indicated costs, which will be discussed in Chapter III.

TABLE 8

ESTIMATED 1990 ANNUAL AGRICULTURAL WATER  
REQUIREMENTS IN NORTH BAY AREA

(In acre-feet)

County	:	Requirement
Solano		42,700 <sup>1/</sup>
Napa		56,700
Sonoma		51,700
Marin		<u>5,100</u>
Total		156,200

<sup>1/</sup> Excludes land within the Solano Irrigation District.

## Summary of Water Requirements

The estimated 1990 water requirements in the North Bay Area for both urban and agricultural uses are set forth, by counties, in Table 9. As previously stated, these estimates, particularly those pertaining to agricultural water requirements, represent the maximum potential requirements, and may be reduced when the several economic factors are fully evaluated.

TABLE 9

### ESTIMATED 1990 ANNUAL WATER REQUIREMENTS IN NORTH BAY AREA

(In acre-feet)

County	:	Urban	:	Agricultural <sup>1/</sup>	:	Total
Solano		58,400		42,700		101,100
Napa		45,100		56,700		101,800
Sonoma		25,500		51,700		77,200
Marin		<u>75,300</u>		<u>5,100</u>		<u>80,400</u>
Totals		204,300		156,200		360,500

<sup>1/</sup> Excludes land within the Solano Irrigation District.

## Supplemental Water Requirements

Future supplemental water requirements in the North Bay Area were computed by subtracting the presently available water supplies from the total estimated 1990 water requirements, considering both urban and agricultural supply and requirements. Consideration was given to the location of the local water supplies and requirements, as well as the changing conditions that will occur in the future, based on the assumed build-up in

demand in urban and agricultural water. For example, it was assumed that the 1,290 acre-feet of water now exported from Napa to Benicia would cease after 1970, and that the ground water presently pumped for agricultural use near Sonoma would be used for urban requirements as a result of urban encroachment on those agricultural lands.

Assuming that supplemental water supplies, other than local water supplies, would become available by about 1966, the maximum potential requirements for supplemental water in the North Bay Area are projected as shown in Table 10.

TABLE 10  
ESTIMATED ANNUAL 1990 SUPPLEMENTAL WATER  
REQUIREMENTS IN NORTH BAY AREA

(In acre-feet)

County	Total water requirements	Available water supply	Supplemental water requirements
Solano	101,100	93,400 <sup>1/</sup>	42,700
Napa	101,800	24,500 <sup>2/</sup>	77,600
Sonoma	77,200	15,400	61,800
Marin	<u>80,400</u>	<u>40,800</u>	<u>39,600</u>
Totals	360,500	174,100	221,700

1/ 33,500 acre-feet available for agricultural use within Solano Irrigation District only.

2/ 300 acre-feet available for use above Conn Reservoir.

The total supplemental water requirement of 221,700 acre-feet shown in Table 10 compares favorably with the 205,000 acre-feet estimated for the North Bay Aqueduct in arriving at an

equitable distribution of the yield from the State Water Facilities. This latter amount has been considered in all of the department's contract negotiations to date.



### CHAPTER III. NORTH BAY AQUEDUCT

The North Bay Aqueduct considered in the evaluation studies is essentially the same project as presented in Bulletin No. 60, "Interim Report to the California State Legislature on the Salinity Control Barrier Investigation", dated March 1957. The project is shown on Plate 1. It would divert water from Lindsey Slough, in Solano County, through an improved Calhoun Cut. A pumping plant at Calhoun Cut would lift water about 15 feet into a concrete-lined canal. A fish screen would be provided for fish protection facilities. The aqueduct would continue generally westerly past Denverton, south of Travis Air Force Base and Fairfield, to Cordelia. At Cordelia a pumping plant would either lift the water for conveyance into Napa Valley by gravity through a 3-mile tunnel through Elkhorn Peak, or would pump the water to the same vicinity through a pressure pipeline up Jameson Canyon, depending upon the capacity of the aqueduct. From Napa Valley the aqueduct would continue westerly, crossing southern Napa County and southern Sonoma and Petaluma Valleys in siphons, and would terminate near Novato in Marin County. The total length of the aqueduct from intake to terminus would be approximately 60 miles.

The general route of the North Bay Aqueduct would be essentially the same regardless of the quantity of water to be delivered, with one major exception. The location of the aqueduct reach from the Cordelia Pumping Plant to Napa County is dependent upon the design flow. For a discharge capacity of 400 second-feet or greater, the Elkhorn Peak Tunnel route would be more

economical, while the Jameson Canyon route would be superior for smaller capacities.

### Criteria for Project Evaluation

Certain basic economic considerations govern the selection of the most desirable capacity of a project, such as the North Bay Aqueduct. These are: (1) the relationship of capital and annual costs to the aqueduct capacity or annual quantity of water to be delivered; (2) the additional costs of distribution and treatment (if necessary) which are part of the total cost of water to the user; (3) the relation of payment capacity for water to the costs thereof; and (4) the costs of water from alternative sources. Formulation of the selected project is achieved through consideration of the interplay of the foregoing factors, wherein each factor is evaluated in light of the others.

### Cost-Capacity Relationship

During the progress of the re-evaluation studies, cost estimates were prepared for several capacities of aqueducts to serve the North Bay Area. These estimates, along with two prior estimates made in June 1960, provided the basis for project evaluation. They are shown in the following tabulation:

<u>Annual delivery</u>	<u>Capital cost</u>
55,500 acre-feet	\$12,914,000
105,000 acre-feet	\$14,942,000
133,000 acre-feet	\$17,108,000
205,000 acre-feet	\$24,714,000
242,000 acre-feet	\$27,718,000



Unit costs of water at canalside for five sizes of aqueduct are summarized in Table 11, utilizing data from the foregoing tabulation as a basis for projecting capital costs. It should be noted that these are costs for water at canalside and do not include the cost of distribution or treatment. It is significant that the figures shown in Table 11 indicate a relatively small variation in unit costs of aqueduct water for a wide range of aqueduct capacities.

TABLE 11  
ESTIMATED UNIT COSTS OF  
NORTH BAY AQUEDUCT WATER AT CANALSIDE  
(In dollars per acre-foot)

Aqueduct capacity : (water delivery in : acre-feet per year) :	Solano : County :	Napa : County :	Sonoma : County :	Marin : County :
55,500 (M&I only)	-----	19.50	-----	35.50
115,600	10.00	20.40	27.10	31.80
133,000	9.80	18.80	25.00	31.20
221,700	8.20	17.00	21.90	27.10
242,000	8.10	16.60	22.00	25.40

The unit costs of water shown in Table 11 were allocated to the respective counties in accordance with the terms set forth in the prototype water service contract between the State and the Metropolitan Water District of Southern California. The contract employs an allocation based upon proportionate use of facilities, and considers both annual water deliveries and aqueduct design

capacity. Allocation factors were determined for each of the north bay counties as the ratio of the 1990 water delivery and aqueduct design capacity for the particular county to the total 1990 water delivery and aqueduct design capacity. In computing the ratio, the proportionate water delivery and design capacity factors were averaged.

Unit costs of water determined by the foregoing method, and shown in Table 11, were based on a 50-year amortization period and reflect an increasing Delta water charge. The Delta water charge, which includes the cost of all development facilities required to maintain a firm supply of project water in the Delta, is forecast to increase from an initial value of \$3.50 per acre-foot as additional developments are required to supplement the State Water Facilities.

#### Distribution Costs

As previously stated, the values shown in Table 11 represent costs of water to the north bay counties at canalside, and do not reflect the additional cost of delivery from the aqueduct to the farm head gate or urban community. While the cost of distribution facilities would not be included in the repayment contract between the State and the water users, such cost must be taken into consideration in assessing water requirements, as distribution facilities are an essential component of total water costs to the water users. Financing of distribution facilities and the repayment thereof are responsibilities of the local contracting agencies.

In order to facilitate the determination of costs of distribution facilities, the North Bay Area was subdivided into

a number of related service areas. In this way it was possible to show the variation in distribution system costs, thereby facilitating the elimination of those areas where the cost of water would exceed the benefits or payment capacity.

Canals and pipelines were located throughout the North Bay Area to deliver water to the vicinity of each service area. The equivalent annual cost of delivering water to each service area through this system was then computed on an acre-foot basis.

Table 12 shows the service areas and the distribution costs that should be added to canalside costs to provide total costs of water to the farm head gate or urban community in each area. It may be noted in Table 12 that as a service area is eliminated from the distribution system the cost to the remaining areas increases.

TABLE 12

ESTIMATED COST OF DISTRIBUTION OF WATER  
TO REPRESENTATIVE SERVICE AREAS WITHIN THE NORTH BAY AREA

(In dollars per acre-foot)

Service area	:Letter: :design-: :nation:	Cost	Remarks
Denverton	A	3.90(a) 4.60(b) 6.50(c)	(a) designated service to A, B, and C
Birds Landing	B	6.40(a)	(b) designated service to A and B
Grizzly Island	C	11.50(a)	(c) designated service to A only
Potrero Hills	D	6.00	
South Suisun	E	2.00	
Jameson Canyon	F	2.00(d)	(d) designated Jameson Canyon route only
Island #1	G	22.80(e)	(e) designated service to G and H
Napa Slough	H	15.90(e)	(f) designated service to H only
Napa Junction	I	6.00	
Suscol Creek	J	2.00	
North Huichica	K	4.00	
North Carneros	L	10.00(g) 10.00(h) 10.40(i)	(g) designated service to L, M, N, O, and P
Northern Napa	M	11.20(g) 11.60(h) 13.80(i)	(h) designated service to L, M, N, and O
North Yountville	N	15.10(g)	(i) designated service to L and M
South St. Helena	O	15.50(g)	
North St. Helena	P	23.90(g)	
Tubbs Island	R	5.00	
Lower Petaluma Valley	S	3.20(i) 3.30(k) 6.50(l)	(j) designated service to S, T, and U
Petaluma	T	14.10(j)	(k) designated service to S and T
West Petaluma	U	23.40(j)	(l) designated service to S only
South Ramal	V	5.00	
Lower Sonoma Valley	W	4.00(m)	(m) designated service to W and X
West Sonoma	X	13.90(m)	(n) designated service to W only

## Quality of Water

Water to supply the proposed North Bay Aqueduct will be diverted directly from the Lindsey Slough area of the Sacramento-San Joaquin Delta. Data on quality of water in this particular portion of the Delta have been collected by the department for a number of years and can be considered as being representative of the quality of the water available for the North Bay Aqueduct. The historical mineral quality of water in Lindsey Slough near Rio Vista is shown in Table 13.

The physical characteristics of water in the Delta in this vicinity, such as turbidity, color, taste, and odor do not present any unusual treatment problems. Water would be suitable for irrigation and some industrial uses without treatment. Use of the water for municipal supply and industrial processing would require complete treatment by conventional methods to improve physical characteristics.

TABLE 13

MINERAL QUALITY OF WATER IN  
LINDSEY SLOUGH NEAR RIO VISTA<sup>1/</sup>

Constituent	:Maximum:	Minimum:	Average
Specific conductance ECx10 <sup>6</sup>	377	153	221
Total dissolved solids - ppm	159	121	143
Chlorides - ppm	27	6	13
Total hardness as CaCO <sub>3</sub> - ppm	139	42	76
Sulfates - ppm	24	11	18
Sodium percentage	51	22	32

<sup>1/</sup> Based on analyses of water samples collected from Lindsey Slough near Rio Vista from 1955 to 1961.

Treatment Costs. The cost of treating water for urban use must be added to canalside and distribution costs in order to reflect the cost of water to urban users. Inasmuch as treatment costs depend to a large extent on the quality of the water supply, the type of treatment desired, and the capacity of the treatment plant, it is difficult to arrive at generalized estimates applicable to all situations. However, an attempt was made to provide a reasonable estimate of capital and annual treatment costs that would be applicable to urban users of water from the North Bay Aqueduct. This was accomplished through review and evaluation of data on file with the department and data obtained from agencies who presently treat their water supplies.

Table 14 presents data on capital and equivalent annual water treatment costs assuming a 20-year buildup to design capacity and a repayment period of 50 years.

TABLE 14

ESTIMATED COSTS OF TREATMENT  
OF WATER FOR URBAN USE

Design capacity :		Capital	:	Equivalent annual costs,		
Million :	Acre-feet :	cost,	:	in dollars		
gallons :	per :	in	:	per acre-foot		
per day :	year :	dollars	:	Capital :	O&M :	Total
0.89	1,000	345,000		24	33	57
1.79	2,000	550,000		20	25	45
2.68	3,000	750,000		18	21	39
3.57	4,000	900,000		16	19	35
5.35	6,000	1,200,000		14	16	30
7.14	8,000	1,450,000		13	14	27
10.70	12,000	1,900,000		11	12	23
14.29	16,000	2,200,000		10	11	21
17.85	20,000	2,500,000		9	10	19
25.0	28,000	3,100,000		8	8	16
32.1	36,000	3,700,000		7	7	14

The estimated costs shown in Table 14 pertain to complete treatment and incorporate the following features: an operations building, chemical feeding equipment, a flash mixing device, flocculation tanks, sedimentation tanks, rapid sand filtration tanks of the open bifurcated type, and a back wash system with sludge disposal basins. The operations building would contain a chlorinator room, a chlorine storage room, chemical storage room, paint and lubricant storage room, maintenance shop, an operator's room and control panel, heating and ventilating equipment, toilet and locker facilities, necessary compressors, pumps and piping along with a standby generator for emergency use in event of a power failure.

## Total Unit Costs of Water

Total unit costs of agricultural water, which represent the summation of the individual cost components discussed in the preceding sections of this chapter, are set forth, by cost components, in Table 15. The cost data shown in Table 15 are representative only, having been developed for a specific aqueduct delivery (116,000 acre-feet per year) and specific service areas. It should be recognized that the total costs of water would be influenced by any modification in either the aqueduct capacity or the location and size of service areas. However, as indicated in Table 11, variation in aqueduct capacity does not materially affect canalside water costs.

TABLE 15

### TYPICAL TOTAL UNIT COSTS OF AGRICULTURAL WATER FROM NORTH BAY AQUEDUCT

(In dollars per acre-foot)

County and service area	: Canalside cost : (average for : county)	: Distri- : bution : cost	: Total : cost
<u>Solano</u>			
Denverton	10.00	4.60	14.60
Birds Landing	10.00	8.40	18.40
Jameson Canyon	10.00	2.00	12.00
<u>Napa</u>			
Napa Junction	20.40	6.00	26.40
Suscol Creek	20.40	2.00	22.40
North Huichica	20.40	4.00	24.40
North Carneros	20.40	10.40	30.40
North Napa	20.40	13.80	34.20
<u>Sonoma</u>			
Tubbs Island	27.10	5.00	32.10
Lower Petaluma Valley	27.10	6.50	33.60
South Ramal	27.10	5.00	32.10
Lower Sonoma Valley	27.10	4.30	31.40
<u>Marin</u>			
Hamilton	31.80	4.00	35.80



Due to the complexities of urban water distribution, no attempt was made to estimate the total cost of urban water service. For comparative purposes, however, the cost of distribution of water from the aqueduct to a treatment plant located in the central part of the urban service area and the cost of water treatment were estimated. These studies resulted in an average total unit cost of urban water of \$48 per acre-foot for Napa County and \$46 per acre-foot for Marin County.

The areas that could be served from a North Bay Aqueduct which would deliver about 116,000 acre-feet of water annually to the North Bay Area are delineated on Plate 2, entitled "Areas of Potential Water Service from North Bay Aqueduct". While studies indicated that only agricultural water would be served in Solano County, Plate 2 also shows an indicated urban service area, resulting from the comments of Solano County.

#### Costs of Water From Other Potential Developments

In order to develop a realistic projection of demand for water and areas to be served from the North Bay Aqueduct, it was necessary to evaluate and compare the probable costs of water from other potential sources -- both local and imported -- with the cost of water from the North Bay Aqueduct. Evaluation of the other potential developments was limited generally to the analysis of data on file with the department and information from other agencies. In this regard, it should be pointed out that the developments discussed in this section are not alternatives

to the North Bay Aqueduct. Rather, they are projects which could serve certain portions of the North Bay Area at costs which would be more attractive than costs of water delivered from the North Bay Aqueduct. These projects will be needed in the future to provide service in the North Bay Area.

The evaluation of potential developments was limited to those projects that could provide significant quantities of water in relation to total water requirements in the North Bay Area. These projects are shown on Plate 3, entitled "Existing and Potential Water Supply Development". The several small local projects which have been proposed by various agencies were considered, but not evaluated, because of the small quantities of water developed and the high capital and unit annual costs involved.

Solano Project. The Solano County Flood Control and Water Conservation District has a contract with the U. S. Bureau of Reclamation to purchase water for irrigation from the Solano Project for \$2.65 per acre-foot. This water is then resold to the Solano Irrigation District for \$2.25 per acre-foot. The latter district distributes and sells the water to agricultural users for an average cost to the farmer of about \$6.75 per acre-foot. This latter amount includes about \$4.50 per acre-foot for local distribution and operation and maintenance of the system. Since water from the North Bay Aqueduct would be more expensive, the service area of the Solano Project was not considered for possible agricultural water service by the North Bay Aqueduct.

In general, the service area of the Solano Project lies north of the proposed route of the North Bay Aqueduct. The area immediately south of the aqueduct route between Travis Air Force Base and Cordelia, while presently not within the Solano Project Service Area, is eligible to join the irrigation district and buy water from that project. It was assumed that that area could obtain Solano Project water for \$6.75 an acre-foot; therefore, the area was not considered for possible water service from the North Bay Aqueduct.

Knights Valley Project. A reservoir at the Knights Valley site on Maacama Creek in the Russian River Basin could develop an annual firm water supply of 45,000 acre-feet for use in Napa Valley. A capital investment of about \$10,000,000 would be required for the dam and reservoir and the pumping and conduit facilities to convey the water to the upper end of Napa Valley. The equivalent annual cost of water delivered to the head waters of the Napa River would be between \$20 and \$25 an acre-foot, assuming utilization of the full yield throughout the repayment period. Distribution and treatment would be added to this cost.

Russian River Development. Additional water supplies for Napa Valley and Marin and southern Sonoma Counties could be secured from the Russian River, provided that storage facilities would firm up the water supply in the river. Three projects which would provide firm water supplies in the Russian River were studied. These were the Dry Creek Project, enlarged Coyote Valley Reservoir, and a storage development on the South Eel River and diversion of water into the Russian River Basin.

The Dry Creek Project is estimated by the Corps of Engineers to cost about \$43,000,000 and to develop a firm annual yield of approximately 90,000 acre-feet of water. The resultant cost of water from this project would average about \$9.50 per acre-foot in the Russian River, assuming the existence of a market for the entire yield of the project.

Enlargement of Coyote Valley Dam on the East Fork of the Russian River is estimated by the Corps of Engineers to cost about \$5,480,000. Such an enlargement would increase the yield about 77,000 acre-feet per year. The cost of providing this additional supply would be about \$4.15 per acre-foot, whereas the yield of the existing Coyote Valley Project costs about \$7.50 per acre-foot. Water from the enlarged project would, therefore, cost between \$4.15 and \$7.50 per acre-foot at the point of diversion in the Russian River. The enlarged project is not considered by the Corps of Engineers to be an alternative to the Dry Creek Project, as it is a future planned development and provides little additional flood control benefits.

Development of a storage project on the South Eel River at the English Ridge site and a diversion into the Russian River is estimated by the department to require a capital expenditure of about \$90,000,000. This project would develop a firm annual yield of about 300,000 acre-feet at a unit cost of about \$8.50 per acre-foot in the Russian River, assuming full annual utilization of the 300,000 acre-feet throughout the entire repayment period. However, if the project were reduced in scale, the unit cost of water in the river would increase to \$9.50 per acre-foot for a yield of 200,000 acre-feet and to \$18

per acre-foot for a yield of 100,000 acre-feet. It should be recognized that a market for 100,000 acre-feet annually from this development would not exist during the early stages of project operation. For this reason, the foregoing costs do not indicate probable costs.

Water in the Russian River firmed up by any of the three foregoing projects could be made available to Napa Valley and to southern Sonoma and Marin Counties by diversion from the river and conveyance to areas of use. Considering the cost of water in the Russian River, the cost of diversion facilities and cost of conveyance, water from this source would have an equivalent cost of from \$24 to \$28 per acre-foot in the upper portion of Napa Valley. Costs for delivery of this water to Sonoma and Petaluma would be about \$54 per acre-foot and \$45 per acre-foot, respectively. Water could be delivered to these latter areas through an aqueduct which would parallel the existing Petaluma and proposed Sonoma aqueducts of the Sonoma County Flood Control and Water Conservation District. The Russian River source would have an advantage that if a Ranney collection system similar to that presently utilized for diversion to Santa Rose could be used, the water might be suitable for urban use with chlorination only.

It should be emphasized that all three of the foregoing Russian River developments are relatively large and that any reduction in size to meet the near future water requirements in the North Bay Area only, would result in a substantial increase in the unit cost of water. In addition to the relatively high unit costs of water, the local water users in the North Bay Area would have the problem of financing these large-scale developments, to the extent that their capital costs would be allocated to conservation.

Walker Creek-San Antonio Project. Development of a reservoir on Walker Creek with subsequent diversion into a San Antonio Reservoir would provide about 25,000 acre-feet of firm annual water supply at a cost of about \$27 per acre-foot in San Antonio Creek, if the full supply is utilized throughout the repayment period. This project would, therefore, make water available in the Petaluma area for \$27 per acre-foot. However, diversion and local distribution would have to be added to this cost. The capital cost of the project would be about \$9,000,000.

Small Local Projects. In addition to the foregoing water developments, there remain several small local projects which have been studied in previous investigations and which were given consideration in this study. Table 16 summarizes the data presently available on these small projects. These data were published in Bulletin No. 3, "The California Water Plan".

TABLE 16

FUTURE LOCAL WATER DEVELOPMENT  
POSSIBILITIES IN NORTH BAY AREA

Reservoir	Stream	County	Storage, in acre-feet	Annual yield, in acre-feet
Bear Creek	Sonoma Creek	Sonoma	4,900	2,700
Spring Valley	unnamed stream <sup>1/</sup>	Napa	7,000	5,400
Sulphur Springs	Sulphur Creek	Napa	6,200	2,900
Wing Canyon	Dry Creek	Napa	12,300	6,500

<sup>1/</sup> Off-stream storage of pumped diversions from Napa River.

Consideration was also given to the possibility of securing an interim water supply for the City of Napa from facilities of the City of Vallejo or from the Solano Project. However, since this would provide only a temporary solution to the water problem, and the city has indicated that it prefers not to purchase water under such an arrangement, this source of supply was eliminated from further study.

#### Payment Capacity

The market for water from the North Bay Aqueduct is, to a large degree, a function of the ability of the potential water users to pay for this water at the indicated costs. Insofar as municipal and industrial water is concerned, payment capacity, or ability, was based on a review and evaluation of the prices that similar areas are presently paying for this type of water supply. In this regard, payment capacity for municipal and industrial water is not considered to be a critical factor, as it was assumed that agencies desiring this type of water would pay any reasonable price under the projected population and industrial expansion. Therefore, it is considered that the demand for municipal and industrial water from the North Bay Aqueduct would not be very sensitive to costs of water.

On the other hand, the demand for agricultural water is extremely sensitive to the cost of water, as water is a substantial item of cost in the farm budget. In view of the importance of the relationship between agricultural payment capacity and demand for water from the North Bay Aqueduct, it was necessary to evaluate in some detail the payment capacities

for the principal crops that could be grown in the North Bay Area. The estimates of payment capacity were made by analysis of costs and return for crops representing approximately 98 percent of all those grown in the area.

In making this analysis, consideration was given specifically to historic yield and price data for climatically adaptable crops. The difference between gross income and crop production costs, including an allowance for management and return on investment, represents the amount per acre which would be available for payment for irrigation water. Table 17 presents the estimated payment capacities for the various crops that could be grown in the North Bay Area.



TABLE 17

ESTIMATED ANNUAL PAYMENT CAPACITY FOR  
SELECTED IRRIGATED CROPS IN NORTH BAY AREA

(In dollars per acre)

Crops	:	Gross	:Costs of production, excluding water management:			:	Total	:	Payment
			Income	Variable	Fixed				
	:	:	:	:	:	:	charge	:	:capacity
Pears	:	770.00	423.65	168.60	115.50	:	707.75	:	62.25
Walnuts	:	405.00	148.70	133.30	40.50	:	322.50	:	82.50
Prunes	:	550.00	262.80	161.35	55.00	:	479.15	:	70.85
Wine grapes	:	270.00	116.70	91.90	27.00	:	235.60	:	34.40
Sweet corn	:	385.00	199.30	77.20	38.50	:	315.00	:	70.00
Cauliflower	:	480.00	258.30	93.20	72.00	:	432.50	:	56.50
Tomatoes	:	405.00	249.55	83.30	40.50	:	373.35	:	31.65
Asparagus	:	276.00	114.00	89.30	27.60	:	230.90	:	45.10
Milo	:	120.00	37.30	44.70	12.00	:	94.00	:	26.00
Corn silage	:	100.00	26.20	40.80	10.00	:	77.00	:	23.00
Sugar beets	:	241.50	117.95	62.90	24.15	:	205.00	:	36.50
Safflower	:	100.00	52.45	30.80	10.00	:	93.25	:	6.75
Corn grain	:	150.00	56.30	42.90	15.00	:	114.20	:	35.80
Barley	:	67.50	22.70	36.55	6.75	:	66.00	:	1.50
Beets	:	70.00	21.50	28.60	7.00	:	57.10	:	12.90
Alfalfa	:	150.00	44.70	57.30	15.00	:	117.00	:	33.00
Grain hay	:	72.00	24.20	34.50	7.20	:	65.90	:	6.10
Pasture (beef)	:	120.00	33.70	52.25	12.00	:	97.95	:	22.05
Pasture (dairy)	:	849.40	480.50	189.70	85.00	:	755.20	:	69.30 <sup>1/</sup>
Double crops	:					:		:	
Barley-milo	:	187.50	60.00	74.00	18.75	:	152.75	:	34.75
Oats-corn silage	:	170.00	50.40	54.40	17.00	:	121.80	:	48.20
Sugar beets-corn	:	391.50	174.25	77.40	39.15	:	290.80	:	100.70
Grain hay-sweet corn	:	456.00	223.50	90.20	45.60	:	359.30	:	96.70
Cauliflower-tomatoes	:	885.00	507.85	137.40	132.75	:	778.00	:	107.00
Cauliflower-sweet corn	:	864.00	457.60	165.60	129.60	:	752.80	:	111.20
Safflower-milo	:	220.00	89.75	62.75	22.00	:	174.50	:	45.50

<sup>1/</sup> Limited by alternative dry-lot feeding.

Utilizing payment capacities estimated for individual crops projected in each service area, a weighted average payment capacity was computed for the service area. Table 18 presents weighted average payment capacities, by service area, for the crops that are assumed to be grown in the North Bay Area under 1990 development. It should be recognized that the projected future cropping pattern is not the same as the present pattern, and that the average payment capacity for each area, shown in Table 18, would vary with a different projection of crop pattern.

TABLE 18

ESTIMATED AVERAGE PAYMENT CAPACITY  
FOR REPRESENTATIVE SERVICE AREAS  
WITHIN NORTH BAY AREA

(In dollars)

Service area	Average payment capacity	
	Per acre	Per acre-foot
Denverton	61	31
Birds Landing	52	25
Grizzley Island	30	17
Potrero Hills	74	36
South Suisun	62	29
Jameson Canyon	83	38
Island No. 1	63	28
Napa Slough	69	31
Napa Junction	73	38
Suscol Creek	63	46
North Huichica	68	37
North Carneros	66	40
North of Napa	63	40
North of Yountville	64	39
South of St. Helena	62	39
North of St. Helena	66	38
Greenwood	77	37
Tubbs Island	67	41
Lower Petaluma Valley	69	39
Petaluma	90	49
East of Petaluma	72	40
South of Ramel	82	41
Lower Sonoma Valley	78	46
West of Sonoma	67	42

## Project Formulation

Formulation of the North Bay Aqueduct was based on the interrelationship of probable cost of water from the aqueduct, cost of water from alternative sources, and payment capacity for agricultural water, all of which factors were discussed and evaluated earlier in this chapter. These factors were weighed for each county within the North Bay Area, and the total projected 1990 requirements for supplemental water were accordingly reduced to a demand that could reasonably be expected to develop for service of water from the North Bay Aqueduct.

By way of review, the requirements for supplemental water within the North Bay Area were estimated in Chapter II to amount to about 222,000 acre-feet per year in 1990. These supplemental water requirements are set forth in Table 19 by principal types of use in each county for 5-year intervals from 1965 to 1990. The projection for intermediate years between 1960 and 1990 enabled the development of a more reasonable demand buildup, utilizing data on population projections and on experience of other similar agricultural areas.

TABLE 19

ESTIMATED ANNUAL REQUIREMENTS FOR SUPPLEMENTAL WATER  
IN NORTH BAY AREA

(In acre-feet)

County and type of use :	Year					
	: 1965	: 1970	: 1975	: 1980	: 1985	: 1990
Solano County						
Agricultural	---	---	18,200	28,000	35,600	42,700
Napa County						
Urban	1,000	2,900	6,000	9,800	15,100	24,700
Agricultural	---	14,000	33,200	27,600	44,500	52,900
Sonoma County						
Urban	---	---	---	2,300	6,000	10,800
Agricultural	---	---	29,200	42,400	47,500	51,000
Marin County						
Urban	---	---	6,000	15,400	24,500	34,500
Agricultural	---	---	2,000	3,000	4,000	5,100
TOTAL	1,000	16,900	95,200	138,500	177,200	221,700

Demands for water from the North Bay Aqueduct were preliminarily projected, based upon informal technical discussions with representatives of counties and of local water service agencies. During these discussions, the department presented information and data on probable costs of water and estimated payment capacities, outlined terms of contracts for water, and received from local interests a preliminary informal indication of interest in water from the North Bay Aqueduct. Following these discussions, representatives of the counties and local water agencies were to submit letters indicating their interest in contracting for water at the indicated costs.

This section discusses the North Bay Aqueduct re-evaluation studies prior to the informal meetings and the adjustments resulting from the expression of interest by the local agencies.

Re-evaluation Studies Prior to the  
Informal Discussions with Local Agencies:

Studies on the re-evaluation of the North Bay Aqueduct prior to the scheduling of technical discussions with the various local agencies consisted generally of the following:

(1) the updating in the office of those data and factors which could have an effect upon the water demand from the North Bay Aqueduct; (2) review and updating of basic data in accordance with the latest information available to the department; and (3) contacts with representatives of potential water users throughout the North Bay Area to apprise them of the preliminary results of the studies and to obtain from them any additional data which would assist the department in conducting its studies. The demands for water from the North Bay Aqueduct projected as a result of these studies are discussed in the following paragraphs:

Solano County. In Solano County, available urban water supplies were considered to be sufficient to meet the projected 1990 urban requirements. Therefore, it was assumed that there would be no interest in urban water from the North Bay Aqueduct prior to that time. In addition, as previously mentioned, those areas adjacent to the Solano Irrigation District were considered to have an available agricultural water supply from the Solano Project at less cost than from the North Bay

Aqueduct. As a result, the 1990 supplemental water requirements (42,700 acre-feet) in Solano County were reduced to a demand of 12,200 acre-feet per year from the North Bay Aqueduct, all of which would be for agricultural use.

Napa County. With respect to Napa County, the future urban water requirements in upper Napa Valley will probably not be served from the North Bay Aqueduct unless the responsible agencies are willing to meet the relatively large cost of water treatment and conveyance. As previously mentioned, other potential projects, namely diversion from the Russian River or Knights Valley, should be considered for serving that area. As a result of these considerations, the 1990 requirements for supplemental water in Napa County (77,600 acre-feet) were reduced to a demand of 44,500 acre-feet per year from the North Bay Aqueduct. This requirement would consist of both urban and agricultural demand in about equal quantities.

Sonoma County. As previously indicated, it is considered that future urban water requirements in Sonoma County can probably be furnished more economically by further enlargement of the Russian River Aqueduct of the Sonoma County Flood Control and Water Conservation District. For this reason, no urban demand is anticipated from the North Bay Aqueduct. In addition, agricultural lands lying generally north of Petaluma and Sonoma are not considered to have sufficient payment capacities to warrant the purchase of North Bay Aqueduct water. As a result, the 1990 supplemental water requirements for Sonoma County (61,800 acre-feet) were reduced

to a demand of 23,600 acre-feet per year from the North Bay Aqueduct, all of which would be used for agricultural purposes in southern Sonoma County.

Marin County. It is indicated that future urban water requirements in Marin County can best be met by service from the North Bay Aqueduct. However, agricultural lands located in the northern portion of the county are not considered as potential users of water from the aqueduct, as the needs for water in that area could be furnished more economically from the Walker-San Antonio Project. Therefore, the 1990 supplemental water requirement in Marin County (39,600 acre-feet) was reduced to a demand of 35,300 acre-feet per year from the North Bay Aqueduct, consisting almost entirely of urban use.

Summary of Demands for Water from North Bay Aqueduct.

The estimated demands for water from the North Bay Aqueduct were projected for the North Bay Area for 5-year intervals in the manner just described for 1990 development. These projected demands are summarized by county in Table 20.

TABLE 20

PROJECTED ANNUAL DEMANDS FOR WATER FROM  
NORTH BAY AQUEDUCT

(In acre-feet)

County and type of use :	Year					
	: 1965 :	1970 :	1975 :	1980 :	1985 :	1990
Solano County Agricultural	---	---	5,200	8,500	10,800	12,200
Napa County Urban	1,000	2,000	4,500	7,700	12,500	21,000
Agricultural	---	2,000	12,000	15,500	19,500	23,500
Sonoma County Agricultural	---	---	14,200	20,500	23,000	23,600
Marin County Urban	---	---	6,600	15,400	24,500	34,500
Agricultural	---	---	400	700	800	800
TOTAL	1,000	4,000	40,900	68,300	91,100	115,600

Adjustment of Water Demand Pursuant to  
Expressions of Interest by Local Agencies

The data and information developed in the re-evaluation studies were presented in a series of meetings and discussions with responsible local water agencies located within each of the four North Bay counties. The department specifically requested that each of these agencies express a formal indication of their position with respect to the North Bay Aqueduct. This expression of local interest was to serve as a guide in the determination by the department as to whether to continue with advanced planning or to hold further studies in abeyance until such time as warranted by increased local interest. As a result of these meetings, the following additional information has been received from each of the counties.



Solano County. Solano County is definitely interested in the North Bay Aqueduct, but questions the economics and local interest in receiving 12,200 acre-feet of agricultural water which is within the payment capacity of certain areas as determined in the re-evaluation study. By letter dated April 13, 1961, from the County Administrator, Solano County indicated that its needs for water from the North Bay Aqueduct in 1990 are on the order of 21,500 acre-feet per year and that this amount would be entirely for municipal and industrial uses in the Benecia-Cordelia-Fairfield area. Subsequent evaluation has disclosed that an additional 3,000 acre-feet annually might be required for municipal and industrial use in the Denverton area. In analyzing its water requirements, Solano County assumes that the imports to the City of Vallejo from the Solano Project and Cache Slough would not be utilized in the Fairfield-Suisun area. This is in contrast with the assumption by the department that the available water supply can be utilized throughout the service area. The county also contemplates full use of water from the Solano Project to meet its minimum contractual urban supplies and expanding irrigation needs.

As a result of comments from Solano County and based upon further analyses, it is indicated that the water from the North Bay Aqueduct should be provided to meet a demand of 24,500 acre-feet for municipal and industrial purposes. Development of the potential market for irrigation water may be dependent upon discussions with and analyses by the landowners.

Napa County. Napa County has expressed a definite interest in the North Bay Aqueduct. However, by letter of March 28, 1961, from the Chairman of the Board of Supervisors, the county has indicated that it is not yet in a position to comment on the amount of water which the re-evaluation study indicated would be required. The letter pointed out that the county has engaged an engineer to study its water supply and water requirements, and that when his report is available the county will be in a better position to evaluate the department's estimate of water requirements. However, the City of Napa, by letter of April 18, 1961, indicated interest in the quantity of municipal and industrial water developed during the re-evaluation studies.

In light of the foregoing letters, the estimate by the department of 23,500 acre-feet of agricultural water and 21,000 acre-feet of urban water demand from the North Bay Aqueduct was considered adequate.

Sonoma County. No official comment was received from the County of Sonoma. However, interests in the southern portion of Sonoma County, and particularly those concerned with agricultural water supply, expressed a definite interest in the North Bay Aqueduct. Consequently, no change was made in the estimated requirements of 23,600 acre-feet of water for agriculture.

Marin County. Letters expressing interest in the North Bay Aqueduct were received from the Marin Municipal Water District and the North Marin County Water District, which agencies

represent the bulk of the area of potential water needs in Marin County. Both water agencies generally agreed with the estimate of the department of a 35,500 acre-foot demand in 1990 for water from the North Bay Aqueduct. However, they did express some concern over the method of repayment of cost of the project. Inasmuch as present water supply development within the county is sufficient until about 1975, and the two agencies are rather fully committed in terms of financial capacity, they would like to be in a position to contract for North Bay Aqueduct and defer payment until such time as they need the water.

Summary of Potential Future Water Demands. The fore-

going comments by local agencies on future water requirements for a portion of the service area of the North Bay Aqueduct indicate that the demands in 1990 will probably be greater than about 116,000 acre-feet as indicated by the economic analyses. Requirements in Solano County may be from 12,000 to 25,000 acre-feet greater than the foregoing estimates and additional urban supplies may be desired in the other counties. On the other hand, the demands on the aqueduct will probably be less than the allowance of 205,000 acre-feet per annum as presently contemplated by the department in the distribution of the initial yield of about 4,000,000 acre-feet from the State Water Facilities. In view of these circumstances, it seems reasonable to make an allowance for 150,000 acre-feet to supply the demands on the North Bay Aqueduct in 1990.

## Project Repayment

As an indication of the approximate year-to-year outlay of money necessary to repay all costs associated with the delivery of water through the North Bay Aqueduct, preliminary annual repayment analyses were prepared for each county for the major types of anticipated water use. These repayment analyses are set forth in Tables 21 and 22.

It should be pointed out that the data shown in both Tables 21 and 22 represent typical repayment schedules, having been prepared for a North Bay Aqueduct designed to deliver 115,600 acre-feet per year, whereas an annual demand of 150,000 acre-feet is considered more realistic. However, as may be noted by reference to Table 11, the increase in annual water delivery from 115,600 acre-feet to 242,000 acre-feet would result in a relatively small effect on the canalside cost of water. Therefore, it is considered that the repayment schedules shown in Tables 21 and 22 are sufficiently representative of annual costs for deliveries through a larger aqueduct. These data can, therefore, be used as a valid guide for each of the north bay counties in arriving at a decision as to whether further negotiations are desired.

It should be noted that the repayment data shown in Tables 21 and 22 refer to canalside costs, and do not include costs of distribution and treatment. However, all costs of delivery at canalside are reflected, including the increasing Delta water charge. The analysis also indicates the higher initial unit cost of water when the demand is low and the manner in which it decreases as the demand builds up. Similar repayment

analyses would be developed for each contracting agency upon the actual determination of the amount and type of water desired by the agency.

The repayment analysis shown in Table 21 is based on the assumption that construction of the North Bay Aqueduct will be initiated in 1964 and will be completed in time to deliver water to Napa County by 1966 and to Marin and Sonoma Counties by about 1972. The repayment analysis shown in Table 22 considers that construction from Lindsey Slough through Napa County will be completed in time to deliver water to Napa County by 1966, but that the aqueduct will not be extended beyond Napa County until 1978 in order to deliver water to Marin and Sonoma Counties in 1980. Since total annual charges to Solano and Napa Counties will be the same regardless of the timing of extension of the aqueduct to Marin and Sonoma Counties, Table 22 contains data for those latter counties only.

Under this latter construction schedule the problem of repayment for the North Bay Aqueduct would be substantially diminished, because timing of construction in relation to the timing of need for supplemental water in various parts of the service area. Water is needed in Napa County in the near future (1966). However, because of new supplies of water being brought into Sonoma and northern Marin Counties and local development of water by the Marin Municipal Utility District, it is not imperative that water be delivered to those counties in the immediate future. It would be possible to construct the aqueduct initially only through Solano and Napa Counties with additional capacity for the quantity of water that Sonoma or Marin Counties may wish

wish to contract for. Construction of the aqueduct could be interrupted at Napa County and its completion into Sonoma and Marin Counties delayed for some agreed upon term. During this interval Marin and Sonoma Counties would be required to repay only the capital costs and fixed maintenance charges for their proportionate share of the reach of aqueduct from Lindsey Slough to Napa County. The pumping facilities in Solano County could also be staged according to water demand.

When the agreed upon span of years had run, the remainder of the aqueduct could be constructed to serve Sonoma and Marin Counties. This would have the effect of reserving, by contract, water for Sonoma and Marin Counties to meet their eventual need, as well as the funds to build the facilities to convey the water. It would delay the repayment of a part of the capital costs, until the present supplies of water are put to use and repayment capacity based on that use is well developed. Solano and Napa Counties would benefit due to sharing costs for the aqueduct reaches in those counties with Sonoma and Marin Counties. The Delta water charge would also be postponed, as it applies only to water actually delivered.

TABLE 21  
TENTATIVE ANNUAL REPAYMENT  
NORTH BAY AQUEDUCT  
CONSTRUCTION SCHEDULE NO. 11/  
(SOLANO COUNTY AGRICULTURAL ONLY)

(In thousands of dollars unless otherwise noted)

FISCAL YEAR (Ending in June)	ANNUAL ENTITLEMENTS (In thousands of acre-feet)	TRANSPORTATION CHARGE				DELTA WATER CHARGE <sup>2/</sup>	TOTAL ANNUAL CHARGES
		Capital Cost Component (As a unit rate)	Minimum O&M <sup>1/</sup> Component	Variable O&M <sup>1/</sup> Component	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1959-60	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0
66	0	0	12.7	0	12.7	0	12.7
67	0	0	12.7	0	12.7	0	12.7
68	0	0	12.7	0	12.7	0	12.7
69	0	0	12.7	0	12.7	0	12.7
1969-70	0	0	12.7	0	12.7	0	12.7
71	0.8	2.7	12.7	0.2	15.6	3.7	19.3
72	2.1	7.0	12.7	0.5	20.2	9.8	30.0
73	3.2	10.6	12.7	0.8	24.1	15.0	39.1
74	4.2	14.0	12.7	1.0	27.7	19.7	47.4
75	5.2	17.3	12.7	1.3	31.3	24.3	55.6
76	6.0	19.9	12.7	1.5	34.1	28.1	62.2
77	6.8	22.6	12.7	1.7	37.0	31.8	68.8
78	7.5	24.9	12.7	1.9	39.5	35.1	74.6
79	8.0	26.6	12.7	2.0	41.3	37.4	78.7
1979-80	8.5	28.3	12.7	2.1	43.1	39.8	82.9
81	9.1	30.2	12.7	2.3	45.2	42.6	87.8
82	9.6	31.9	12.7	2.4	47.0	60.5	107.5
83	10.0	33.2	12.7	2.5	48.4	63.0	111.4
84	10.4	34.6	12.7	2.6	49.9	65.5	115.4
85	10.8	35.9	12.7	2.7	51.3	68.0	119.3
86	11.0	36.6	12.7	2.7	52.0	69.3	121.3
87	11.3	37.6	12.7	2.8	53.1	71.2	124.3
88	11.7	38.9	12.7	2.9	54.5	73.7	128.2
89	12.0	39.9	12.7	3.0	55.6	75.6	131.2
1989-90	12.2	40.6	12.7	3.0	56.3	76.9	133.2
91	12.2	40.6	12.7	3.0	56.3	76.9	133.2
92	12.2	40.6	12.7	3.0	56.3	76.9	133.2
93	12.2	40.6	12.7	3.0	56.3	76.9	133.2
94	12.2	40.6	12.7	3.0	56.3	76.9	133.2
95	12.2	40.6	12.7	3.0	56.3	76.9	133.2
96	12.2	40.6	12.7	3.0	56.3	76.9	133.2
97	12.2	40.6	12.7	3.0	56.3	76.9	133.2
98	12.2	40.6	12.7	3.0	56.3	76.9	133.2
99	12.2	40.6	12.7	3.0	56.3	76.9	133.2
1999-00	12.2	40.6	12.7	3.0	56.3	76.9	133.2
01	12.2	40.6	12.7	3.0	56.3	76.9	133.2
02	12.2	40.6	12.7	3.0	56.3	76.9	133.2
03	12.2	40.6	12.7	3.0	56.3	76.9	133.2
04	12.2	40.6	12.7	3.0	56.3	76.9	133.2
05	12.2	40.6	12.7	3.0	56.3	76.9	133.2
06	12.2	40.6	12.7	3.0	56.3	76.9	133.2
07	12.2	40.6	12.7	3.0	56.3	76.9	133.2
08	12.2	40.6	12.7	3.0	56.3	76.9	133.2
09	12.2	40.6	12.7	3.0	56.3	76.9	133.2
2009-10	12.2	40.6	12.7	3.0	56.3	76.9	133.2
11	12.2	40.6	12.7	3.0	56.3	76.9	133.2
12	12.2	40.6	12.7	3.0	56.3	76.9	133.2
13	12.2	40.6	12.7	3.0	56.3	76.9	133.2
14	12.2	40.6	12.7	3.0	56.3	76.9	133.2
15	12.2	40.6	12.7	3.0	56.3	76.9	133.2
16	12.2	40.6	12.7	3.0	56.3	76.9	133.2
17	12.2	40.6	12.7	3.0	56.3	76.9	133.2
18	12.2	40.6	12.7	3.0	56.3	76.9	133.2
19	12.2	40.6	12.7	3.0	56.3	76.9	133.2
2019-20	12.2	40.6	12.7	3.0	56.3	76.9	133.2
21	12.2	40.6	12.7	3.0	56.3	76.9	133.2
22	12.2	40.6	12.7	3.0	56.3	76.9	133.2
23	12.2	40.6	12.7	3.0	56.3	76.9	133.2
24	12.2	40.6	12.7	3.0	56.3	76.9	133.2
25	12.2	40.6	12.7	3.0	56.3	76.9	133.2
26	12.2	40.6	12.7	3.0	56.3	76.9	133.2
27	12.2	40.6	12.7	3.0	56.3	76.9	133.2
28	12.2	40.6	12.7	3.0	56.3	76.9	133.2
29	12.2	40.6	12.7	3.0	56.3	76.9	133.2
2029-30	12.2	40.6	12.7	3.0	56.3	76.9	133.2
31	12.2	40.6	12.7	3.0	56.3	76.9	133.2
32	12.2	40.6	12.7	3.0	56.3	76.9	133.2
33	12.2	40.6	12.7	3.0	56.3	76.9	133.2
34	12.2	40.6	12.7	3.0	56.3	76.9	133.2
35	12.2	40.6	12.7	3.0	56.3	76.9	133.2
36	12.2	40.6	12.7	3.0	56.3	76.9	133.2
37	12.2	40.6	12.7	3.0	56.3	76.9	133.2
38	12.2	40.6	12.7	3.0	56.3	76.9	133.2

(1) Construction beyond Napa County deferred until 1970.

(2) The Delta Water Charge, as shown in Column 6, is based upon \$3.50 per acre-foot through 12/69; \$4.68 per acre-foot from 1/70 through 6/81; and \$6.30 per acre-foot from 7/81 through 6/2038.

TABLE 21 (CONTINUED)

TENTATIVE ANNUAL REPAYMENT  
NORTH BAY AQUEDUCT  
CONSTRUCTION SCHEDULE NO. 1/  
(NAPA COUNTY AGRICULTURAL PORTION)

(In thousands of dollars unless otherwise noted)

FISCAL YEAR (Ending in June)	ANNUAL ENTITLEMENTS (In thousands of acre-feet)	TRANSPORTATION CHARGE				DELTA WATER 2/ CHARGE	TOTAL ANNUAL CHARGES
		Capital Cost Component (As a unit rate)	Minimum O&M Component	Variable O&M Component	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1959-60	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	62.6	0	62.6	0	62.6
66	0	0	62.6	0	62.6	0	62.6
67	0	0	62.6	0	62.6	0	62.6
68	0	0	62.6	0	62.6	0	62.6
69	0	0	62.6	0	62.6	0	62.6
1969-70	2.0	16.8	62.6	4.4	83.8	9.4	93.2
71	5.7	48.0	62.6	12.4	123.0	26.7	149.7
72	8.5	71.6	62.6	18.5	152.7	39.8	192.5
73	10.5	88.4	62.6	22.9	173.9	49.1	223.0
74	11.7	98.5	62.6	25.5	186.6	54.8	241.4
75	12.0	101.0	62.6	26.2	189.8	56.2	246.0
76	13.0	109.5	62.6	28.4	200.5	60.8	261.3
77	13.6	114.5	62.6	29.7	206.8	63.6	270.4
78	14.2	119.6	62.6	31.0	213.2	66.5	279.7
79	15.0	126.3	62.6	32.7	221.6	70.2	291.8
1979-80	15.5	130.5	62.6	33.8	226.9	73.5	299.4
81	16.4	138.1	62.6	35.8	236.5	76.4	313.3
82	17.1	144.0	62.6	37.3	243.9	107.7	351.6
83	18.0	151.6	62.6	39.3	253.5	113.4	366.9
84	18.8	158.3	62.6	41.0	261.9	118.4	380.3
85	19.5	164.2	62.6	42.5	269.3	122.9	392.2
86	20.4	171.8	62.6	44.1	278.9	128.5	407.4
87	21.1	177.7	62.6	46.0	286.3	132.9	419.2
88	22.0	185.2	62.6	48.0	295.8	138.6	434.4
89	22.8	192.0	62.6	49.7	304.3	143.6	447.9
1989-90	23.5	197.9	62.6	51.3	311.8	148.1	459.9
91	23.5	197.9	62.6	51.3	311.8	148.1	459.9
92	23.5	197.9	62.6	51.3	311.8	148.1	459.9
93	23.5	197.9	62.6	51.3	311.8	148.1	459.9
94	23.5	197.9	62.6	51.3	311.8	148.1	459.9
95	23.5	197.9	62.6	51.3	311.8	148.1	459.9
96	23.5	197.9	62.6	51.3	311.8	148.1	459.9
97	23.5	197.9	62.6	51.3	311.8	148.1	459.9
98	23.5	197.9	62.6	51.3	311.8	148.1	459.9
99	23.5	197.9	62.6	51.3	311.8	148.1	459.9
1999-00	23.5	197.9	62.6	51.3	311.8	148.1	459.9
01	23.5	197.9	62.6	51.3	311.8	148.1	459.9
02	23.5	197.9	62.6	51.3	311.8	148.1	459.9
03	23.5	197.9	62.6	51.3	311.8	148.1	459.9
04	23.5	197.9	62.6	51.3	311.8	148.1	459.9
05	23.5	197.9	62.6	51.3	311.8	148.1	459.9
06	23.5	197.9	62.6	51.3	311.8	148.1	459.9
07	23.5	197.9	62.6	51.3	311.8	148.1	459.9
08	23.5	197.9	62.6	51.3	311.8	148.1	459.9
09	23.5	197.9	62.6	51.3	311.8	148.1	459.9
2009-10	23.5	197.9	62.6	51.3	311.8	148.1	459.9
11	23.5	197.9	62.6	51.3	311.8	148.1	459.9
12	23.5	197.9	62.6	51.3	311.8	148.1	459.9
13	23.5	197.9	62.6	51.3	311.8	148.1	459.9
14	23.5	197.9	62.6	51.3	311.8	148.1	459.9
15	23.5	197.9	62.6	51.3	311.8	148.1	459.9
16	23.5	197.9	62.6	51.3	311.8	148.1	459.9
17	23.5	197.9	62.6	51.3	311.8	148.1	459.9
18	23.5	197.9	62.6	51.3	311.8	148.1	459.9
19	23.5	197.9	62.6	51.3	311.8	148.1	459.9
2019-20	23.5	197.9	62.6	51.3	311.8	148.1	459.9
21	23.5	197.9	62.6	51.3	311.8	148.1	459.9
22	23.5	197.9	62.6	51.3	311.8	148.1	459.9
23	23.5	197.9	62.6	51.3	311.8	148.1	459.9
24	23.5	197.9	62.6	51.3	311.8	148.1	459.9
25	23.5	197.9	62.6	51.3	311.8	148.1	459.9
26	23.5	197.9	62.6	51.3	311.8	148.1	459.9
27	23.5	197.9	62.6	51.3	311.8	148.1	459.9
28	23.5	197.9	62.6	51.3	311.8	148.1	459.9
29	23.5	197.9	62.6	51.3	311.8	148.1	459.9
2029-30	23.5	197.9	62.6	51.3	311.8	148.1	459.9
31	23.5	197.9	62.6	51.3	311.8	148.1	459.9
32	23.5	197.9	62.6	51.3	311.8	148.1	459.9
33	23.5	197.9	62.6	51.3	311.8	148.1	459.9
34	23.5	197.9	62.6	51.3	311.8	148.1	459.9
35	23.5	197.9	62.6	51.3	311.8	148.1	459.9
36	23.5	197.9	62.6	51.3	311.8	148.1	459.9
37	23.5	197.9	62.6	51.3	311.8	148.1	459.9
38	23.5	197.9	62.6	51.3	311.8	148.1	459.9

(1) Construction beyond Napa County deferred until 1970.

(2) The Delta Water Charge, as shown in Column 6, is based upon \$3.50 per acre-foot through 12/69; \$4.68 per acre-foot from 1/70 through 6/81; and \$6.30 per acre-foot from 7/81 through 6/2038.



TABLE 21 (CONTINUED)  
TENTATIVE ANNUAL REPAYMENT  
NORTH BAY AQUEDUCT  
CONSTRUCTION SCHEDULE NO. 12/  
(NAPA COUNTY, MUNICIPAL AND INDUSTRIAL PORTION)  
(In thousands of dollars unless otherwise noted)

FISCAL YEAR (Ending in June)	ANNUAL ENTITLEMENTS (In thousands of acre-feet)	TRANSPORTATION CHARGE					DELTA WATER CHARGE <sup>2/</sup>	TOTAL ANNUAL CHARGES
		Capital Cost Component		Minimum O&M Component	Variable O&M Component	Total		
		Interest at 4%	Principal					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1959-60	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0
Repayment starts								
65	1.0	75.0	12.3	40.8	1.6	129.7	3.5	133.2
66	1.2	75.0	12.3	40.8	1.9	130.0	4.2	134.2
67	1.4	75.0	12.3	40.8	2.2	130.3	4.9	135.2
68	1.6	75.0	12.3	40.8	2.5	130.6	5.6	136.2
69	1.8	75.0	12.3	40.8	2.8	130.9	6.3	137.2
1969-70	2.0	75.0	12.3	40.8	3.2	131.3	9.4	140.7
71	2.5	75.0	12.3	40.8	4.0	132.1	11.7	143.8
72	3.0	76.5	12.5	40.8	4.7	134.5	14.0	148.5
73	3.5	76.5	12.5	40.8	5.5	135.3	16.4	151.7
74	4.0	76.5	12.5	40.8	6.3	136.1	18.7	154.8
75	4.5	76.5	12.5	40.8	7.1	136.9	21.1	158.0
76	5.0	77.9	12.8	40.8	7.9	139.4	23.4	162.8
77	5.5	77.9	12.8	40.8	8.7	140.2	25.7	165.9
78	6.0	77.9	12.8	40.8	9.5	141.0	28.1	169.1
79	7.0	77.9	12.8	40.8	11.1	142.6	32.8	175.4
1979-80	7.7	77.9	12.8	40.8	12.2	143.7	36.0	179.7
81	8.5	77.9	12.8	40.8	13.4	144.9	39.8	184.7
82	9.5	79.4	13.0	40.8	15.0	148.2	59.9	208.1
83	10.5	79.4	13.0	40.8	16.6	149.8	66.2	216.0
84	11.5	79.4	13.0	40.8	18.2	151.4	72.5	223.9
85	12.5	79.4	13.0	40.8	19.8	153.0	78.8	231.8
86	13.5	79.4	13.0	40.8	21.3	154.5	85.1	239.6
87	15.0	79.4	13.0	40.8	23.7	156.9	94.5	251.4
88	17.0	79.4	13.0	40.8	26.9	160.1	107.1	267.2
89	18.5	79.4	13.0	40.8	29.2	162.4	116.6	279.0
1989-90	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
91	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
92	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
93	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
94	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
95	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
96	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
97	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
98	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
99	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
1999-00	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
01	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
02	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
03	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
04	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
05	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
06	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
07	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
08	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
09	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
2009-10	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
11	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
12	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
13	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
14	21.0	79.4	13.0	40.8	33.2	166.4	132.3	298.7
15	21.0	4.4	0.7	40.8	33.2	79.1	132.3	211.4
16	21.0	4.4	0.7	40.8	33.2	79.1	132.3	211.4
17	21.0	4.4	0.7	40.8	33.2	79.1	132.3	211.4
18	21.0	4.4	0.7	40.8	33.2	79.1	132.3	211.4
19	21.0	4.4	0.7	40.8	33.2	79.1	132.3	211.4
2019-20	21.0	4.4	0.7	40.8	33.2	79.1	132.3	211.4
21	21.0	2.9	0.5	40.8	33.2	77.4	132.3	209.7
22	21.0	2.9	0.5	40.8	33.2	77.4	132.3	209.7
23	21.0	2.9	0.5	40.8	33.2	77.4	132.3	209.7
24	21.0	2.9	0.5	40.8	33.2	77.4	132.3	209.7
25	21.0	1.5	0.2	40.8	33.2	75.7	132.3	208.0
26	21.0	1.5	0.2	40.8	33.2	75.7	132.3	208.0
27	21.0	1.5	0.2	40.8	33.2	75.7	132.3	208.0
28	21.0	1.5	0.2	40.8	33.2	75.7	132.3	208.0
29	21.0	1.5	0.2	40.8	33.2	75.7	132.3	208.0
2029-30	21.0	1.5	0.2	40.8	33.2	75.7	132.3	208.0
31	21.0	0	0	40.8	33.2	74.0	132.3	206.3
32	21.0	0	0	40.8	33.2	74.0	132.3	206.3
33	21.0	0	0	40.8	33.2	74.0	132.3	206.3
34	21.0	0	0	40.8	33.2	74.0	132.3	206.3
35	21.0	0	0	40.8	33.2	74.0	132.3	206.3
36	21.0	0	0	40.8	33.2	74.0	132.3	206.3
37	21.0	0	0	40.8	33.2	74.0	132.3	206.3
38	21.0	0	0	40.8	33.2	74.0	132.3	206.3

- (1) Construction beyond Napa County deferred until 1970.  
(2) The Delta Water Charge, as shown in Column 7, is based upon \$3.50 per acre-foot through 12/69; \$4.68 per acre-foot from 1/70 through 6/81; and \$6.30 per acre-foot from 7/81 through 6/2038.

TABLE 21 (CONTINUED)

**TENTATIVE ANNUAL REPAYMENT  
NORTH BAY AQUEDUCT  
CONSTRUCTION SCHEDULE NO. 12/  
(SONOMA COUNTY AGRICULTURAL ONLY)**

(In thousands of dollars, unless otherwise noted)

FISCAL YEAR (Ending in June)	ANNUAL ENTITLEMENTS (In thousands of acre-feet)	TRANSPORTATION CHARGE				DELTA WATER CHARGE <sup>2/</sup>	TOTAL ANNUAL CHARGES
		Capital Cost Component (As a unit rate)	Minimum O&M <sup>1/</sup> Component	Variable O&M <sup>1/</sup> Component	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1959-60	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0
66	0	0	62.8	0	62.8	0	62.8
67	0	0	62.8	0	62.8	0	62.8
68	0	0	62.8	0	62.8	0	62.8
69	0	0	62.8	0	62.8	0	62.8
1969-70	0	0	62.8	0	62.8	0	62.8
71	0	0	62.8	0	62.8	0	62.8
72	5.0	64.1	62.8	10.9	137.8	23.4	161.2
73	9.0	115.5	75.7	19.6	210.8	42.1	252.9
74	12.0	153.9	75.7	26.1	255.7	56.2	311.9
75	14.2	162.2	75.7	30.9	268.8	66.5	335.3
76	16.0	205.2	75.7	34.9	315.8	74.9	390.7
77	17.5	224.5	75.7	38.2	338.4	81.9	420.3
78	18.8	241.1	75.7	41.0	357.8	88.0	445.8
79	19.8	254.0	75.7	43.2	378.9	92.7	465.6
1979-80	20.5	263.0	75.7	44.7	383.4	95.9	479.3
81	21.3	273.2	75.7	46.5	395.4	99.7	495.1
82	22.0	282.2	75.7	48.0	405.9	133.6	539.5
83	22.3	286.1	75.7	48.7	410.5	140.5	551.0
84	22.7	291.2	75.7	49.5	416.4	143.0	559.4
85	23.0	295.0	75.7	50.2	420.9	144.9	565.8
86	23.2	297.6	75.7	50.6	423.9	146.2	570.1
87	23.4	300.2	75.7	51.1	427.0	147.4	574.4
88	23.6	302.7	75.7	51.5	429.9	148.7	578.6
89	23.6	302.7	75.7	51.5	429.9	148.7	578.6
1989-90	23.6	302.7	75.7	51.5	429.9	148.7	578.6
91	23.6	302.7	75.7	51.5	429.9	148.7	578.6
92	23.6	302.7	75.7	51.5	429.9	148.7	578.6
93	23.6	302.7	75.7	51.5	429.9	148.7	578.6
94	23.6	302.7	75.7	51.5	429.9	148.7	578.6
95	23.6	302.7	75.7	51.5	429.9	148.7	578.6
96	23.6	302.7	75.7	51.5	429.9	148.7	578.6
97	23.6	302.7	75.7	51.5	429.9	148.7	578.6
98	23.6	302.7	75.7	51.5	429.9	148.7	578.6
99	23.6	302.7	75.7	51.5	429.9	148.7	578.6
1999-00	23.6	302.7	75.7	51.5	429.9	148.7	578.6
01	23.6	302.7	75.7	51.5	429.9	148.7	578.6
02	23.6	302.7	75.7	51.5	429.9	148.7	578.6
03	23.6	302.7	75.7	51.5	429.9	148.7	578.6
04	23.6	302.7	75.7	51.5	429.9	148.7	578.6
05	23.6	302.7	75.7	51.5	429.9	148.7	578.6
06	23.6	302.7	75.7	51.5	429.9	148.7	578.6
07	23.6	302.7	75.7	51.5	429.9	148.7	578.6
08	23.6	302.7	75.7	51.5	429.9	148.7	578.6
09	23.6	302.7	75.7	51.5	429.9	148.7	578.6
2009-10	23.6	302.7	75.7	51.5	429.9	148.7	578.6
11	23.6	302.7	75.7	51.5	429.9	148.7	578.6
12	23.6	302.7	75.7	51.5	429.9	148.7	578.6
13	23.6	302.7	75.7	51.5	429.9	148.7	578.6
14	23.6	302.7	75.7	51.5	429.9	148.7	578.6
15	23.6	302.7	75.7	51.5	429.9	148.7	578.6
16	23.6	302.7	75.7	51.5	429.9	148.7	578.6
17	23.6	302.7	75.7	51.5	429.9	148.7	578.6
18	23.6	302.7	75.7	51.5	429.9	148.7	578.6
19	23.6	302.7	75.7	51.5	429.9	148.7	578.6
2019-20	23.6	302.7	75.7	51.5	429.9	148.7	578.6
21	23.6	302.7	75.7	51.5	429.9	148.7	578.6
22	23.6	302.7	75.7	51.5	429.9	148.7	578.6
23	23.6	302.7	75.7	51.5	429.9	148.7	578.6
24	23.6	302.7	75.7	51.5	429.9	148.7	578.6
25	23.6	302.7	75.7	51.5	429.9	148.7	578.6
26	23.6	302.7	75.7	51.5	429.9	148.7	578.6
27	23.6	302.7	75.7	51.5	429.9	148.7	578.6
28	23.6	302.7	75.7	51.5	429.9	148.7	578.6
29	23.6	302.7	75.7	51.5	429.9	148.7	578.6
2029-30	23.6	302.7	75.7	51.5	429.9	148.7	578.6
31	23.6	302.7	75.7	51.5	429.9	148.7	578.6
32	23.6	302.7	75.7	51.5	429.9	148.7	578.6
33	23.6	302.7	75.7	51.5	429.9	148.7	578.6
34	23.6	302.7	75.7	51.5	429.9	148.7	578.6
35	23.6	302.7	75.7	51.5	429.9	148.7	578.6
36	23.6	302.7	75.7	51.5	429.9	148.7	578.6
37	23.6	302.7	75.7	51.5	429.9	148.7	578.6
38	23.6	302.7	75.7	51.5	429.9	148.7	578.6

(1) Construction beyond Napa County deferred until 1970.

(2) The Delta Water Charge, as shown in Column 6, is based upon \$3.50 per acre-foot through 12/69; \$4.68 per acre-foot from 1/70 through 6/81; and \$6.30 per acre-foot from 7/81 through 6/2038.

TABLE 21 (CONTINUED)

TENTATIVE ANNUAL REPAYMENT  
NORTH BAY AQUEDUCT  
CONSTRUCTION SCHEDULE NO. 1<sup>1/</sup>  
(MARIN COUNTY MUNICIPAL AND INDUSTRIAL ONLY)

(In thousands of dollars unless otherwise noted)

FISCAL YEAR (Ending in June)	ANNUAL ENTITLEMENTS (In thousands of acre-feet)	TRANSPORTATION CHARGE					DELTA WATER CHARGE <sup>2/</sup>	TOTAL ANNUAL CHARGES
		Capitol Cost Component		Minimum O&M <sup>R</sup> Component	Variable O&M <sup>R</sup> Component	Total		
		Interest at 4%	Principal					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1959-60	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0
65	0	164.5	26.9	0	0	0	0	0
66	0	164.5	26.9	69.2	0	191.4	0	191.4
67	0	164.5	26.9	69.2	0	260.6	0	260.6
68	0	164.5	26.9	69.2	0	260.6	0	260.6
69	0	164.5	26.9	69.2	0	260.6	0	260.6
1969-70	0	198.8	32.5	69.2	0	300.5	0	300.5
71	0	242.9	39.8	69.2	0	351.9	0	351.9
72	1.4	323.5	53.0	69.2	2.2	447.9	6.6	454.5
73	3.4	323.5	53.0	93.3	5.4	475.2	15.9	491.1
74	5.4	323.5	53.0	93.3	8.5	478.3	25.3	503.6
75	7.0	323.5	53.0	93.3	11.0	480.8	32.8	513.6
76	9.0	326.0	53.4	93.3	14.2	486.9	42.1	529.0
77	10.5	326.0	53.4	93.3	16.6	489.3	49.1	538.4
78	12.6	326.0	53.4	93.3	19.9	492.6	60.0	552.6
79	14.1	326.0	53.4	93.3	22.3	495.0	66.0	561.0
1979-80	16.2	326.0	53.4	93.3	25.4	498.1	75.3	573.4
81	17.7	326.0	53.4	93.3	28.0	500.7	82.8	583.5
82	19.7	328.4	53.8	93.3	31.1	506.6	124.1	630.7
83	21.7	328.4	53.8	93.3	34.3	509.8	136.7	646.5
84	23.2	328.4	53.8	93.3	36.6	512.1	146.2	658.3
85	25.3	328.4	53.8	93.3	40.0	515.5	159.4	674.9
86	27.3	328.4	53.8	93.3	43.1	518.6	172.0	690.6
87	28.8	328.4	53.8	93.3	45.5	521.0	181.4	702.4
88	31.3	328.4	53.8	93.3	49.4	524.9	197.2	722.1
89	33.3	328.4	53.8	93.3	52.6	528.1	209.8	737.9
1989-90	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
91	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
92	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
93	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
94	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
95	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
96	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
97	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
98	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
99	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
1999-00	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
01	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
02	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
03	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
04	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
05	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
06	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
07	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
08	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
09	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
2009-10	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
11	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
12	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
13	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
2013-14	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
15	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
16	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
17	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
18	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
19	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
2019-20	35.3	129.7	21.2	93.3	55.8	300.0	222.4	522.4
21	35.3	85.5	14.0	93.3	55.8	248.6	222.4	471.0
22	35.3	4.9	0.8	93.3	55.8	154.8	222.4	377.2
23	35.3	4.9	0.8	93.3	55.8	154.8	222.4	377.2
24	35.3	4.9	0.8	93.3	55.8	154.8	222.4	377.2
25	35.3	4.9	0.8	93.3	55.8	154.8	222.4	377.2
26	35.3	2.4	0.4	93.3	55.8	151.9	222.4	374.3
27	35.3	2.4	0.4	93.3	55.8	151.9	222.4	374.3
28	35.3	2.4	0.4	93.3	55.8	151.9	222.4	374.3
29	35.3	2.4	0.4	93.3	55.8	151.9	222.4	374.3
2029-30	35.3	2.4	0.4	93.3	55.8	151.9	222.4	374.3
31	35.3	0	0	93.3	55.8	149.1	222.4	371.5
32	35.3	0	0	93.3	55.8	149.1	222.4	371.5
33	35.3	0	0	93.3	55.8	149.1	222.4	371.5
34	35.3	0	0	93.3	55.8	149.1	222.4	371.5
35	35.3	0	0	93.3	55.8	149.1	222.4	371.5
36	35.3	0	0	93.3	55.8	149.1	222.4	371.5
37	35.3	0	0	93.3	55.8	149.1	222.4	371.5
38	35.3	0	0	93.3	55.8	149.1	222.4	371.5

(1) Construction beyond Napa County deferred until 1970.

(2) The Delta Water Charge, as shown in Column 7, is based upon \$3.50 per acre-foot through 12/69; \$4.68 per acre-foot from 1/70 through 6/81; and \$6.30 per acre-foot from 7/81 through 6/2038.

TABLE 22

TENTATIVE ANNUAL REPAYMENT  
NORTH BAY AQUEDUCT  
CONSTRUCTION SCHEDULE NO. 2<sup>1/</sup>  
(SOMOMA COUNTY AGRICULTURAL ONLY)

(In thousands of dollars unless otherwise noted)

FISCAL YEAR (Ending in June)	ANNUAL ENTITLEMENTS (In thousands of acre-feet)	TRANSPORTATION CHARGE				DELTA WATER CHARGE <sup>2/</sup>	TOTAL ANNUAL CHARGES
		Capital Cost Component (As a unit rate)	Minimum O&M <sup>2/</sup> Component	Variable O&M <sup>2/</sup> Component	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1959-60	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0
66	0	0	62.8	0	62.8	0	62.8
67	0	0	62.8	0	62.8	0	62.8
68	0	0	62.8	0	62.8	0	62.8
69	0	0	62.8	0	62.8	0	62.8
1969-70	0	0	62.8	0	62.8	0	62.8
71	0	0	62.8	0	62.8	0	62.8
72	0	0	62.8	0	62.8	0	62.8
73	0	0	62.8	0	62.8	0	62.8
74	0	0	62.8	0	62.8	0	62.8
75	0	0	62.8	0	62.8	0	62.8
76	0	0	62.8	0	62.8	0	62.8
77	0	0	62.8	0	62.8	0	62.8
78	0	0	62.8	0	62.8	0	62.8
79	0	0	62.8	0	62.8	0	62.8
1979-80	5.0	85.6	62.8	10.9	159.3	23.4	182.7
81	9.0	154.0	75.7	19.6	249.3	42.1	291.4
82	18.0	205.4	74.7	26.1	307.2	75.6	382.8
83	14.2	243.0	75.7	30.9	349.6	89.5	439.1
84	16.0	273.8	75.7	34.9	384.4	100.8	485.2
85	17.5	299.5	75.7	38.2	413.4	110.2	523.6
86	18.8	321.7	75.7	41.0	438.4	118.4	556.8
87	19.8	338.8	75.7	43.2	457.7	124.7	582.4
88	20.5	350.8	75.7	44.7	471.2	129.2	600.4
89	21.3	364.5	75.7	46.5	486.7	134.2	620.9
1989-90	22.0	376.5	75.7	48.0	500.2	138.6	638.8
91	22.3	381.6	75.7	48.7	506.0	140.5	646.5
92	22.7	388.5	75.7	49.5	513.7	141.0	656.7
93	23.0	393.6	75.7	50.2	519.5	144.9	664.4
94	23.2	397.0	75.7	50.6	523.3	146.2	669.5
95	23.4	400.4	75.7	51.1	527.2	147.4	674.6
96	23.6	403.9	75.7	51.5	531.1	148.7	679.8
97	23.6	403.9	75.7	51.5	531.1	148.7	679.8
98	23.6	403.9	75.7	51.5	531.1	148.7	679.8
99	23.6	403.9	75.7	51.5	531.1	148.7	679.8
1999-00	23.6	403.9	75.7	51.5	531.1	148.7	679.8
01	23.6	403.9	75.7	51.5	531.1	148.7	679.8
02	23.6	403.9	75.7	51.5	531.1	148.7	679.8
03	23.6	403.9	75.7	51.5	531.1	148.7	679.8
04	23.6	403.9	75.7	51.5	531.1	148.7	679.8
05	23.6	403.9	75.7	51.5	531.1	148.7	679.8
06	23.6	403.9	75.7	51.5	531.1	148.7	679.8
07	23.6	403.9	75.7	51.5	531.1	148.7	679.8
08	23.6	403.9	75.7	51.5	531.1	148.7	679.8
09	23.6	403.9	75.7	51.5	531.1	148.7	679.8
2009-10	23.6	403.9	75.7	51.5	531.1	148.7	679.8
11	23.6	403.9	75.7	51.5	531.1	148.7	679.8
12	23.6	403.9	75.7	51.5	531.1	148.7	679.8
13	23.6	403.9	75.7	51.5	531.1	148.7	679.8
14	23.6	403.9	75.7	51.5	531.1	148.7	679.8
15	23.6	403.9	75.7	51.5	531.1	148.7	679.8
16	23.6	403.9	75.7	51.5	531.1	148.7	679.8
17	23.6	403.9	75.7	51.5	531.1	148.7	679.8
18	23.6	403.9	75.7	51.5	531.1	148.7	679.8
19	23.6	403.9	75.7	51.5	531.1	148.7	679.8
2019-20	23.6	403.9	75.7	51.5	531.1	148.7	679.8
21	23.6	403.9	75.7	51.5	531.1	148.7	679.8
22	23.6	403.9	75.7	51.5	531.1	148.7	679.8
23	23.6	403.9	75.7	51.5	531.1	148.7	679.8
24	23.6	403.9	75.7	51.5	531.1	148.7	679.8
25	23.6	403.9	75.7	51.5	531.1	148.7	679.8
26	23.6	403.9	75.7	51.5	531.1	148.7	679.8
27	23.6	403.9	75.7	51.5	531.1	148.7	679.8
28	23.6	403.9	75.7	51.5	531.1	148.7	679.8
29	23.6	403.9	75.7	51.5	531.1	148.7	679.8
2029-30	23.6	403.9	75.7	51.5	531.1	148.7	679.8
31	23.6	403.9	75.7	51.5	531.1	148.7	679.8
32	23.6	403.9	75.7	51.5	531.1	148.7	679.8
33	23.6	403.9	75.7	51.5	531.1	148.7	679.8
34	23.6	403.9	75.7	51.5	531.1	148.7	679.8
35	23.6	403.9	75.7	51.5	531.1	148.7	679.8
36	23.6	403.9	75.7	51.5	531.1	148.7	679.8
37	23.6	403.9	75.7	51.5	531.1	148.7	679.8
38	23.6	403.9	75.7	51.5	531.1	148.7	679.8

(1) Construction beyond Napa County deferred until 1978.

(2) The Delta Water Charge, as shown in Column 6, is based upon \$3.50 per acre-foot through 12/69; \$4.68 per acre-foot from 1/70 through 6/81; and \$6.30 per acre-foot from 7/81 through 6/2038.

TABLE 22 (CONTINUED)

TENTATIVE ANNUAL REPAYMENT  
NORTH BAY AQUEDUCT  
CONSTRUCTION SCHEDULE NO. 21/  
(MARIN COUNTY MUNICIPAL AND INDUSTRIAL ONLY)

(In thousands of dollars unless otherwise noted)

FISCAL YEAR Ending in June)	ANNUAL ENTITLEMENTS (In thousands of acre-feet)	TRANSPORTATION CHARGE					DELTA WATER CHARGE <sup>2/</sup>	TOTAL ANNUAL CHARGES
		Capital Cost Component		Minimum O&M/R Component	Variable O&M/R Component	Total		
		Interest at 4%	Principal					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1959-60	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0
65	0	164.5	26.9	0	0	191.4	0	191.4
66	0	164.5	26.9	69.2	0	260.6	0	260.6
67	0	164.5	26.9	69.2	0	260.6	0	260.6
68	0	164.5	26.9	69.2	0	260.6	0	260.6
69	0	164.5	26.9	69.2	0	260.6	0	260.6
1969-70	0	164.5	26.9	69.2	0	260.6	0	260.6
71	0	164.5	26.9	69.2	0	260.6	0	260.6
72	0	167.0	27.3	69.2	0	263.5	0	263.5
73	0	167.0	27.3	69.2	0	263.5	0	263.5
74	0	167.0	27.3	69.2	0	263.5	0	263.5
75	0	167.0	27.3	69.2	0	263.5	0	263.5
76	0	169.5	27.7	69.2	0	266.4	0	266.4
77	0	203.8	33.3	69.2	0	306.3	0	306.3
78	0	247.9	40.6	69.2	0	357.7	0	357.7
79	0	326.0	53.4	69.2	0	448.6	0	448.6
1979-80	16.1	326.0	53.4	93.3	25.4	498.1	75.3	573.4
81	17.7	326.0	53.4	93.3	26.0	500.7	82.8	583.5
82	19.7	328.4	53.8	93.3	31.1	506.6	124.1	630.7
83	21.7	328.4	53.8	93.3	34.3	509.8	136.7	646.5
84	23.2	328.4	53.8	93.3	36.6	512.1	146.2	658.3
85	25.3	328.4	53.8	93.3	40.0	515.5	159.4	674.9
86	27.3	328.4	53.8	93.3	43.1	518.6	172.0	690.6
87	28.8	328.4	53.8	93.3	45.5	521.0	181.4	702.4
88	31.3	328.4	53.8	93.3	49.4	524.9	197.2	722.1
89	33.3	328.4	53.8	93.3	52.6	528.1	209.8	737.9
1989-90	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
91	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
92	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
93	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
94	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
95	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
96	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
97	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
98	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
99	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
1999-00	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
01	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
02	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
03	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
04	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
05	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
06	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
07	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
08	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
09	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
2009-10	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
11	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
12	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
13	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
14	35.3	328.4	53.8	93.3	55.8	531.3	222.4	753.7
15	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
16	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
17	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
18	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
19	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
2019-20	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
21	35.3	163.9	26.8	93.3	55.8	339.8	222.4	562.2
22	35.3	161.4	26.4	93.3	55.8	336.9	222.4	559.3
23	35.3	161.4	26.4	93.3	55.8	336.9	222.4	559.3
24	35.3	161.4	26.4	93.3	55.8	336.9	222.4	559.3
25	35.3	161.4	26.4	93.3	55.8	336.9	222.4	559.3
26	35.3	158.9	26.0	93.3	55.8	334.0	222.4	556.4
27	35.3	124.6	20.4	93.3	55.8	294.1	222.4	516.5
28	35.3	80.5	13.1	93.3	55.8	242.7	222.4	465.1
29	35.3	2.4	.4	93.3	55.8	151.9	222.4	374.3
2029-30	35.3	2.4	.4	93.3	55.8	151.9	222.4	374.3
31	35.3	0	0	93.3	55.8	149.1	222.4	371.5
32	35.3	0	0	93.3	55.8	149.1	222.4	371.5
33	35.3	0	0	93.3	55.8	149.1	222.4	371.5
34	35.3	0	0	93.3	55.8	149.1	222.4	371.5
35	35.3	0	0	93.3	55.8	149.1	222.4	371.5
36	35.3	0	0	93.3	55.8	149.1	222.4	371.5
37	35.3	0	0	93.3	55.8	149.1	222.4	371.5
38	35.3	0	0	93.3	55.8	149.1	222.4	371.5

- (1) Construction beyond Napa County deferred until 1978.
- (2) The Delta Water Charge, as shown in Column 7, is based upon \$3.50 per acre-foot through 12/69; \$4.68 per acre-foot from 1/70 through 6/81; and \$6.30 per acre-foot from 7/81 through 6/2038.



#### CHAPTER IV. FUTURE WATER DEVELOPMENT IN NORTH BAY AREA

As defined in Chapter I, the North Bay Area includes those portions of the counties of Marin, Sonoma, Napa, and Solano which drain into the San Francisco Bay. This area is considerably larger than the area proposed to be served from the North Bay Aqueduct, as described in Chapter III.

The responsibilities and obligations of the Department of Water Resources to formulate plans for the development and utilization of the water resources of the State in a manner most beneficial to the people of the State are clearly set forth in the statutes and by various legislative actions. As indicated in Chapter I, the department recognizes this obligation by indicating that one of the objectives of the re-evaluation study is to recommend future water supply development for the entire North Bay Area in addition to the re-evaluation of the North Bay Aqueduct.

As described in Chapter III, the North Bay Aqueduct was formulated on the basis of available information and discussion with local interests. The aqueduct capacity selected would best serve the needs for water in only a portion of the North Bay Area. With regard to near-future water needs, it is recognized that certain local projects and imports from the Russian River could develop water at a lower unit cost than water from the North Bay Aqueduct in the areas at distances from and substantially higher elevations than the aqueduct. It is also recognized that, with respect to long-range water requirements, imported water from the Russian and Eel River Basins will necessarily supplement the North Bay Aqueduct for service of the

North Bay Area beyond 1990. However, it is considered that the North Bay Aqueduct is the initial feature of a water resource development program for the North Bay Area. The first stage development will provide water service primarily to southern Solano, Napa, and Sonoma Counties and to the urban areas of Marin County. Formulation and timing of the projects to follow the North Bay Aqueduct will require additional detailed studies by the department. These studies are currently in progress.

Data and information presented in Chapter III indicate that a Knights Valley Project could serve water to upper Napa Valley for about \$20 to \$25 per acre-foot; the Walker-San Antonio Project could serve water in the Petaluma area for about \$27 per acre-foot; and water in the Russian River could be firmed-up from either Dry Creek Project or an enlarged Coyote Valley Project for about \$7.50 to \$9.50 per acre-foot in the Russian River. The cost of water developed and imported from the Eel River (English Ridge) would vary widely with the size of project and the rate of buildup in use of the developed supplies. Immediate utilization of a firm water supply of 300,000 acre-feet annually upon completion of the project would result in costs of about \$8.50 per acre-foot in the Russian River. This, of course, would be an entirely unrealistic premise, as the demand for full project yield would build up over a period of years.

Additional studies are necessary on these projects, particularly with respect to coordination of their operation with existing and proposed near-future facilities. In addition, water development projects on the Eel River must include consideration of the water requirements in the North Coastal Area



as well as the North Bay Area. In this regard, studies of the development of the Eel River for both the North Coastal and North Bay Areas have been in progress by the department since 1957. These studies have received added emphasis with the passage of Senate Concurrent Resolution No. 47 by the 1961 Legislature. This resolution requests the department to proceed as quickly as feasible to make a comprehensive survey of the Eel River watershed area in relation to the water, flood control, and watershed-management needs of the eight counties which are members of the Eel River Flood Control and Water Conservation Association.

Upon completion of the foregoing studies by the department, recommendations will be made with respect to staging and timing of construction of water development projects (in addition to the North Bay Aqueduct) to meet the needs for supplemental water for the entire North Bay Area. In view of the indicated water needs and the timing of those needs, the North Bay Aqueduct is clearly indicated as the initial feature in a comprehensive water development program, which will eventually provide a solution to the water problems in the North Bay Area.

The North Bay Aqueduct is now authorized, has a dependable water supply, and funds are available for its construction. No other source of water now under consideration meets those tests. The water supply and funds will be available until December 31, 1963, after which time they will be subject to requirements of other areas desiring service from the State Water Facilities.



## CHAPTER V. CONCLUSIONS AND RECOMMENDATIONS

As a result of field investigation, discussions with local interests, and study and analysis of available data concerning water requirements and costs of water supplies available to the North Bay Area, the following conclusions and recommendations are made.

### Conclusions

1. The North Bay Aqueduct is the most feasible initial development to meet near-future requirements for supplemental water in the North Bay Area. The aqueduct should be placed under construction immediately to ensure the delivery of water to Napa County by 1966. As a minimum, the aqueduct should be constructed initially from Lindsey Slough to the vicinity of Napa to provide service to Solano and Napa Counties, with provision for capacity to permit later extension westerly to Marin and Sonoma Counties.

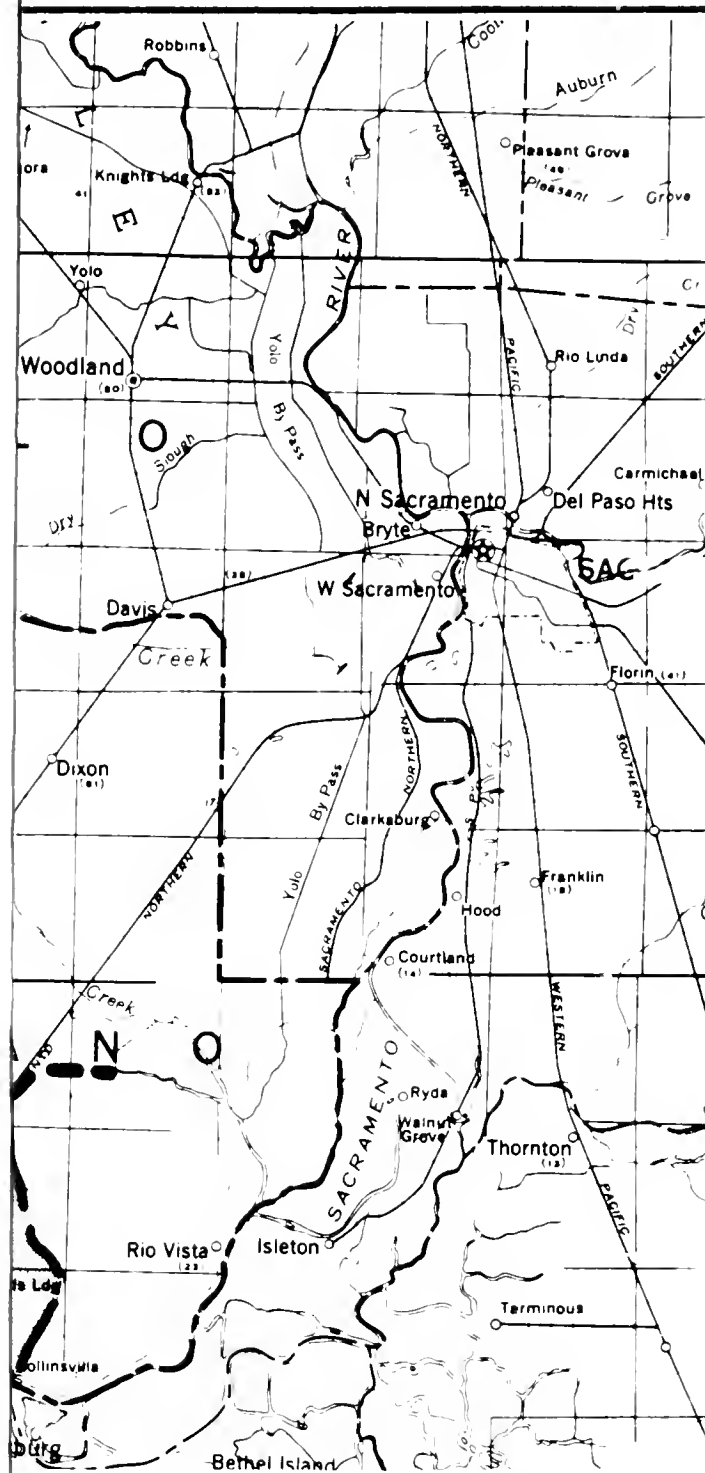
2. Local projects, such as the Knights Valley and the Walker-San Antonio Projects, and import projects, such as the Dry Creek and English Ridge Projects with subsequent diversion from the Russian River, are complementary rather than alternatives to the North Bay Aqueduct. These projects should be considered for development of supplemental water:

a. For the portions of the North Bay Area where service from the North Bay Aqueduct would be too costly, prior to 1990; and

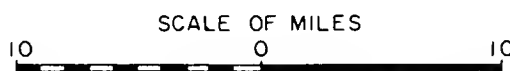
b. For the entire North Bay Area subsequent to 1990.

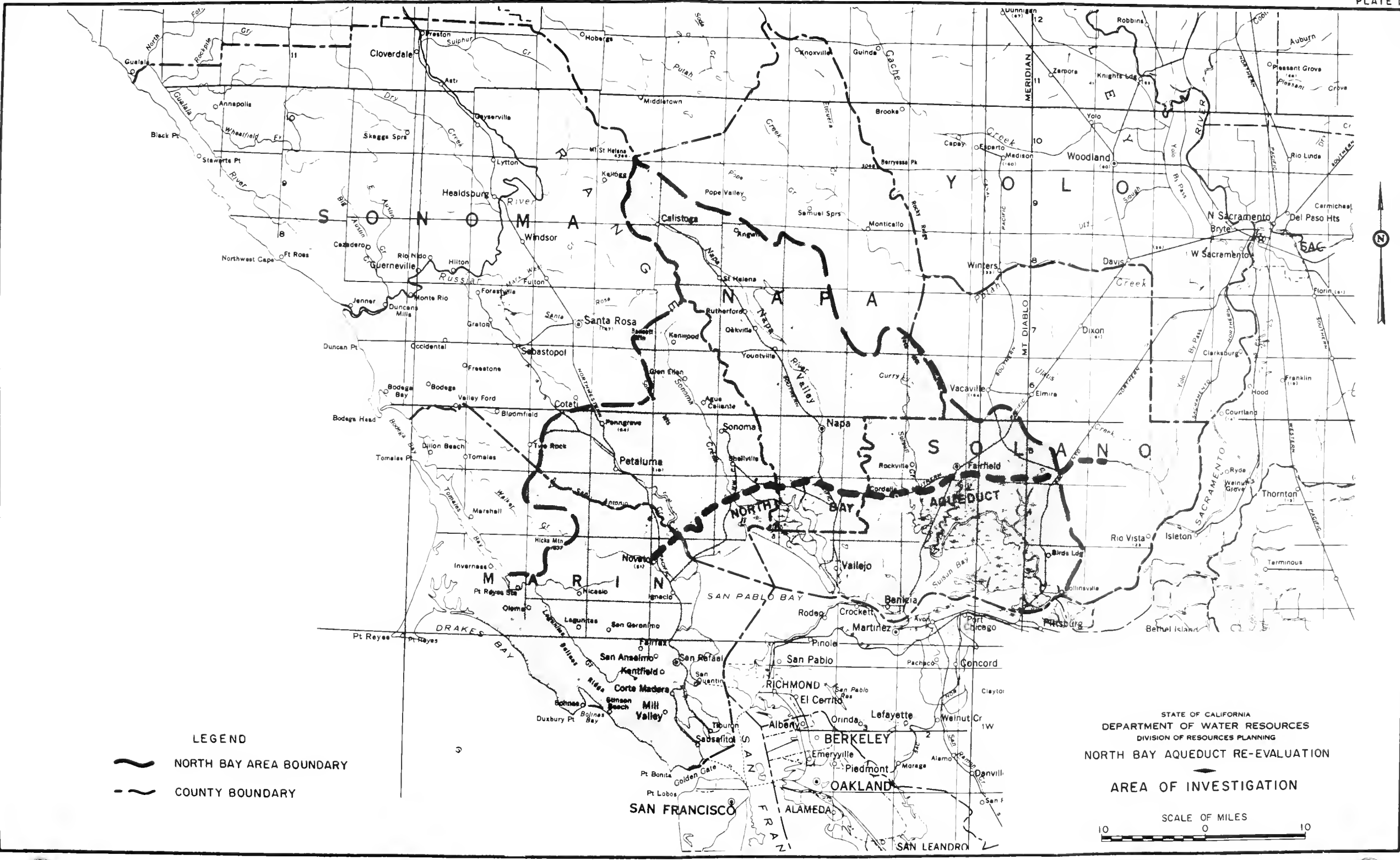
#### Recommendations

It is recommended that representatives of the four north bay counties and of water agencies within those counties, after a careful study of this report, together with such other data as may be available, indicate to the department their intentions as to whether to proceed with negotiations looking toward the execution of contracts for purchase of water from the North Bay Aqueduct.



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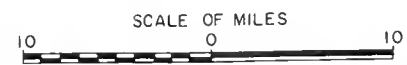


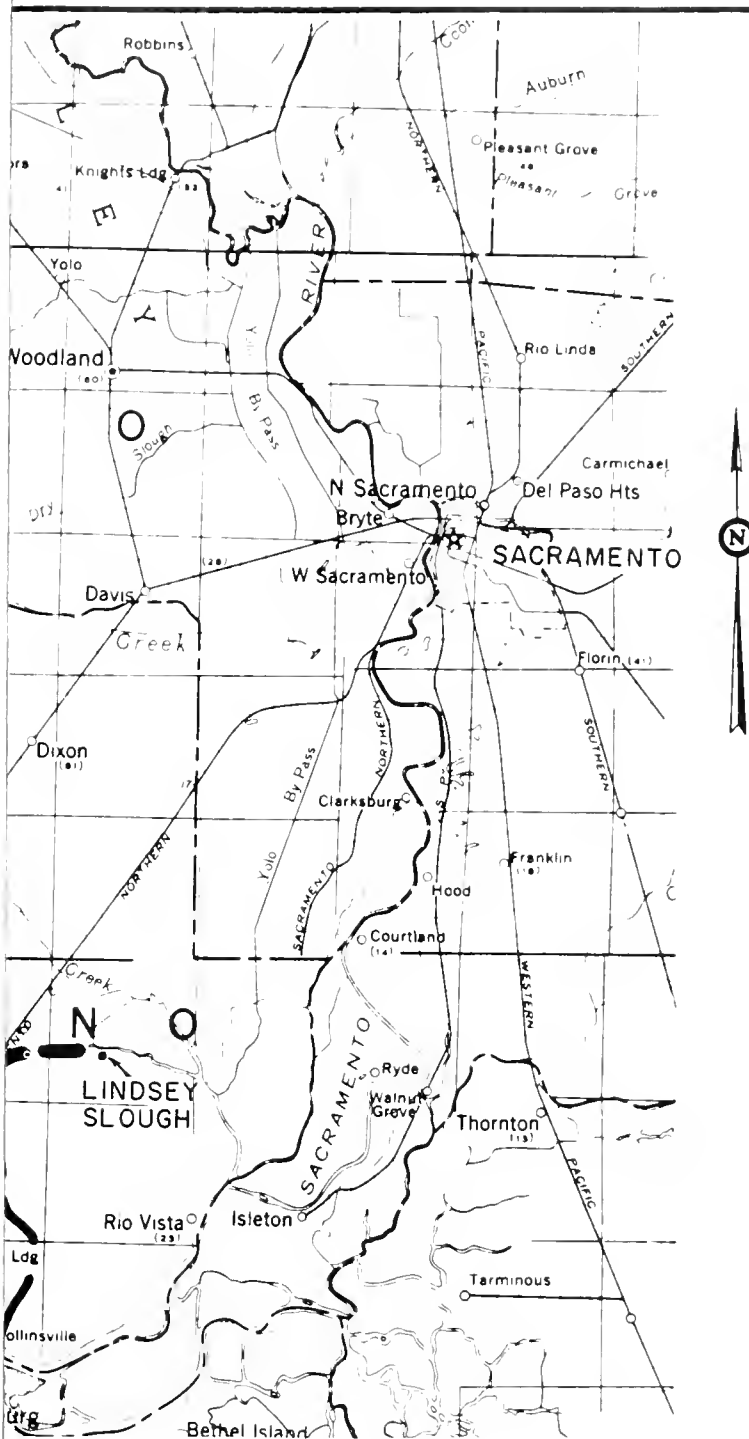


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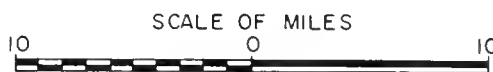
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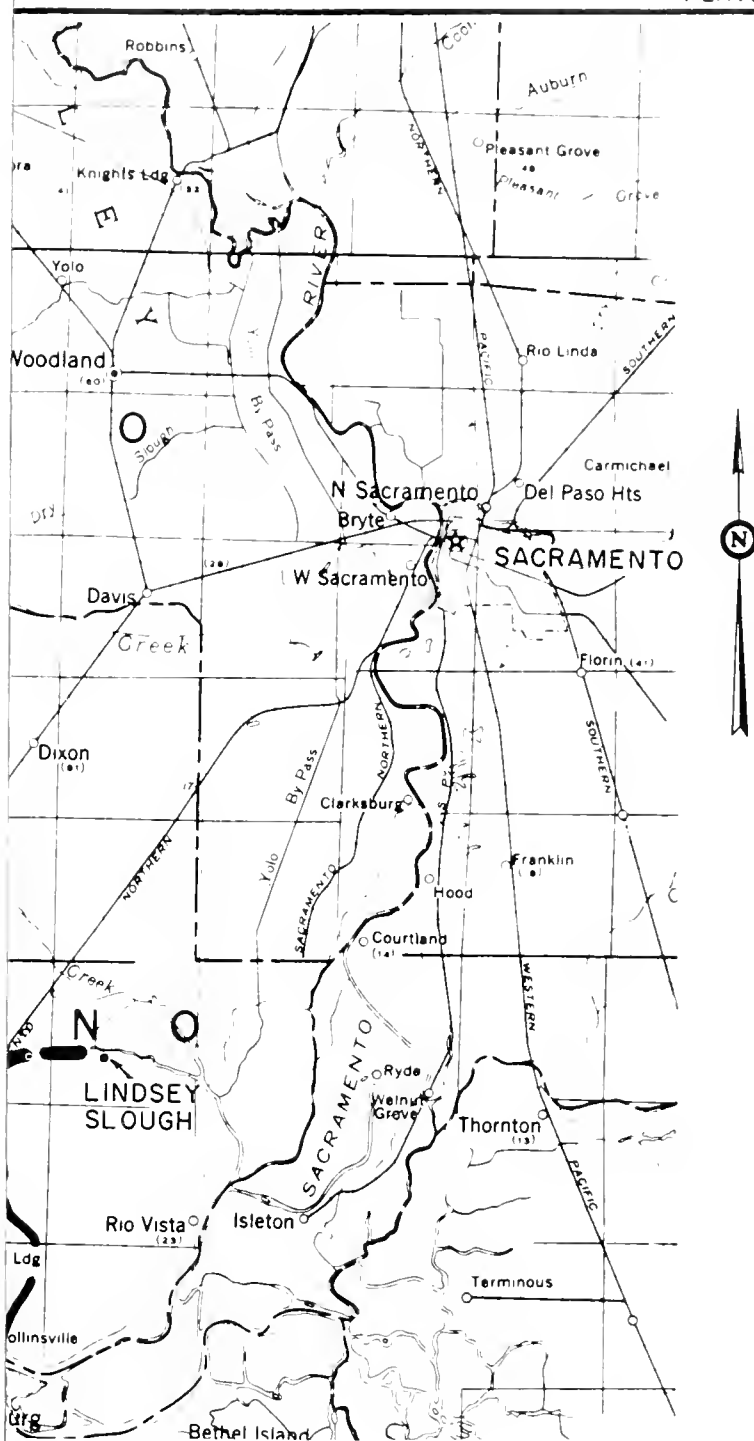


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 FROM NORTH BAY AQUEDUCT

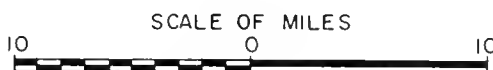


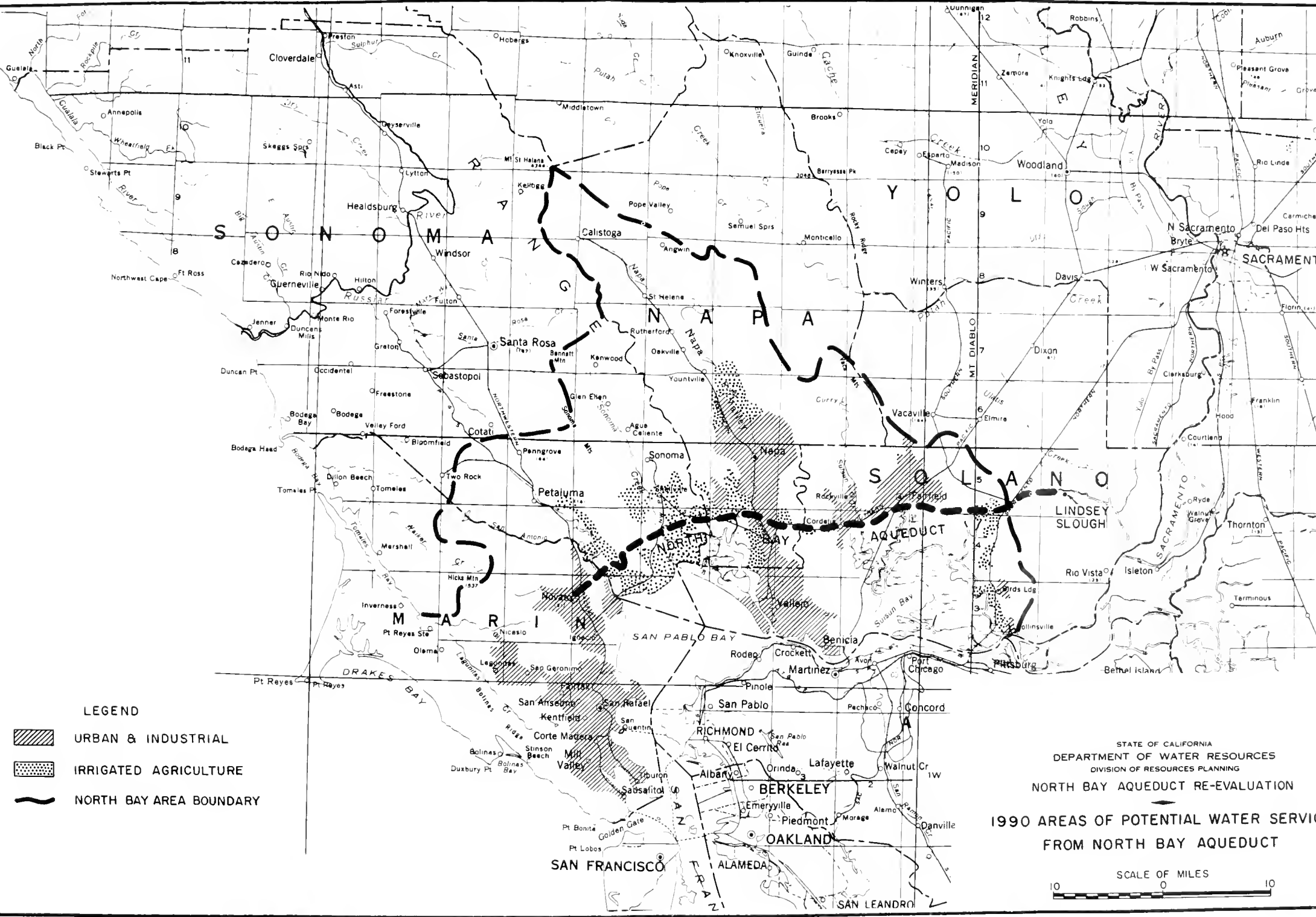









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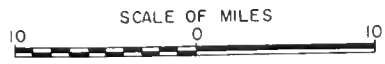


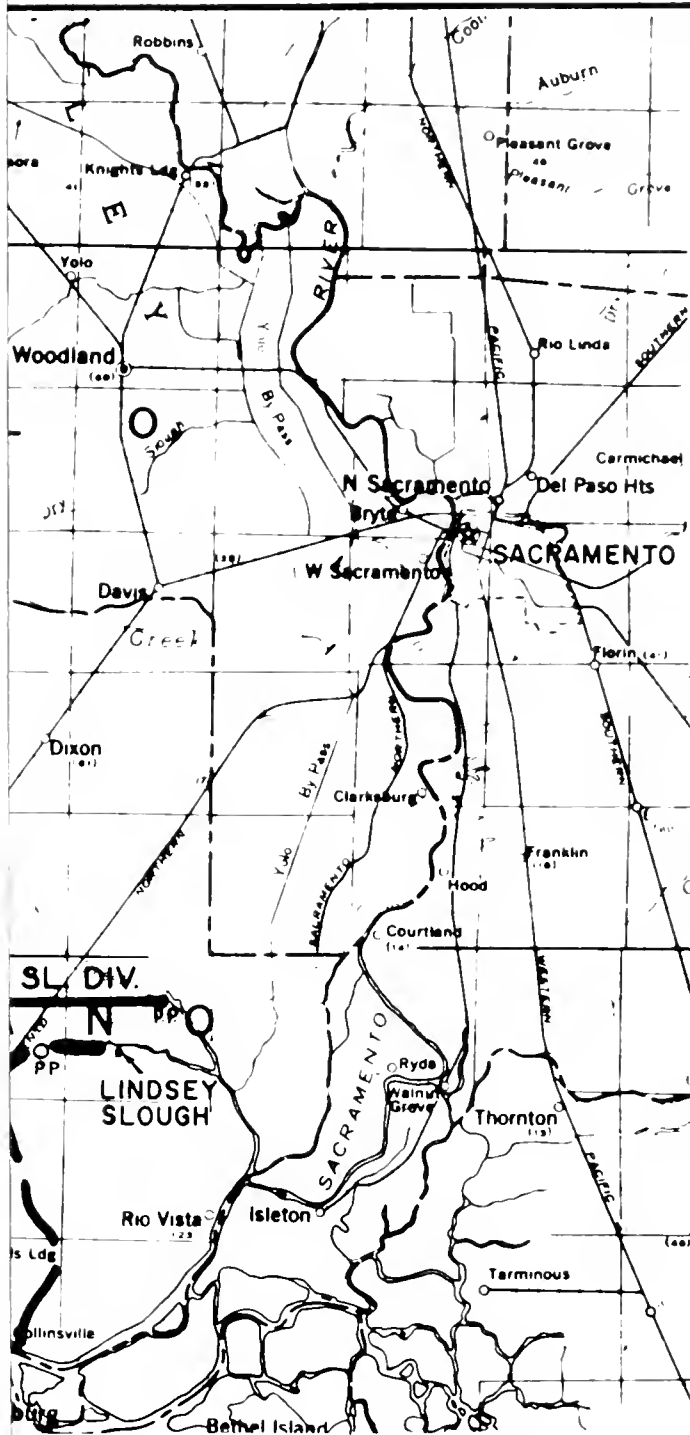


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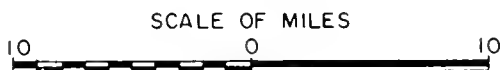
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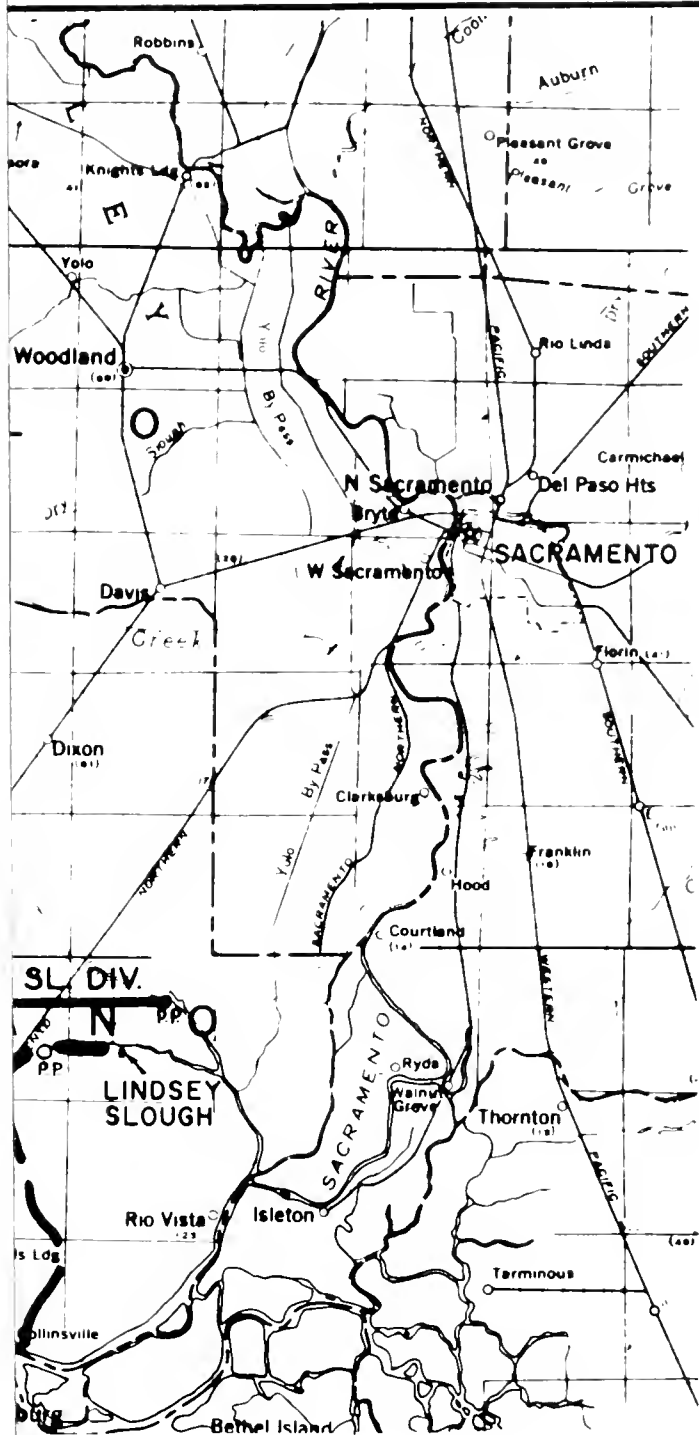


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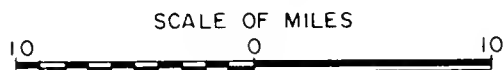


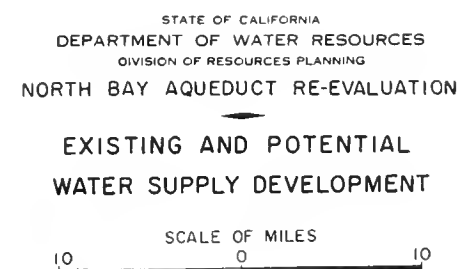




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